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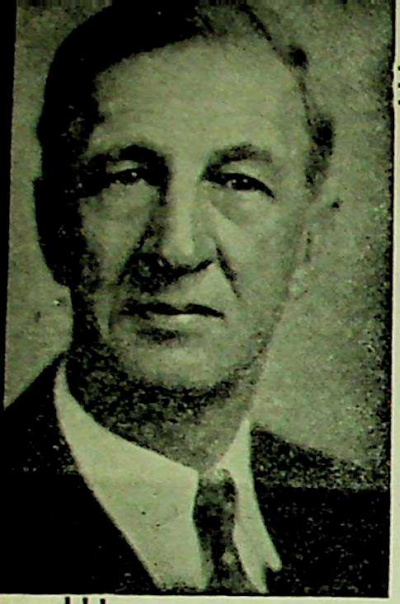


TAKE TIME

Here is a quotation from the *Santa Fe Magazine* which appealed to me as containing much good, common sense. I hope you too will enjoy it—perhaps profit by it:

"Take time to live. That is what time is for. Killing time is suicide.

"Take time to work. It is the price of success.

"Take time to think. It is the source of power.

"Take time to play. It is the fountain of wisdom.

"Take time to be friendly. It is the road to happiness.

"Take time to dream. It is hitching your wagon to a star.

"Take time to look around. It is too short a day to be selfish.

"Take time to laugh. It is the music of the soul.

"Take time to play with children. It is the joy of joys.

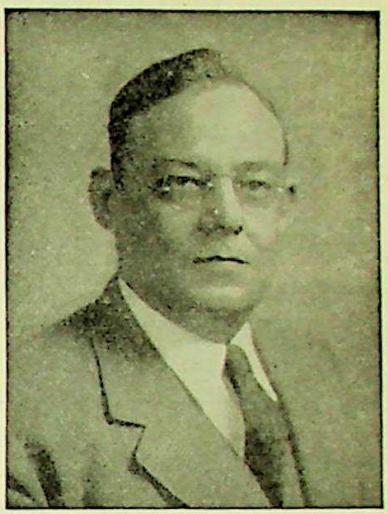
"Take time to be courteous. It is the mark of a gentleman."

J. E. Smith, *President.*

Using an AC-DC Receiver in the NRI Practical Training Plan

By J. B. STRAUGHN

NRI Supervisor of Training



J. B. Straughn

FOR years we have recommended an a.c.-operated superheterodyne for the NRI Practical Training Plan because the circuits are more complex than in an a.c.-d.c. receiver, and because it is possible to carry out more experiments with this type of set than with an a.c.-d.c. receiver.

However, most modern receivers are a.c.-d.c. operated. This is not because the a.c.-d.c. set is better than an a.c.-operated receiver using a power transformer, but because an a.c.-d.c. set costs less to manufacture, and, therefore, can be sold for less. AC-operated receivers are becoming increasingly difficult to obtain.

Since most of the receivers you will service will be a.c.-d.c. operated, it will be just as well for you to use this type of receiver for the Training Plan. If you have already carried out the Training Plan on an a.c.-operated set, it would be worth your while to repeat the Plan on an a.c.-d.c. receiver. Here is the information you will need for this type of receiver for the Practical Training Plan.

Do not obtain a 3-way portable or a battery-operated receiver for the Practical Training Plan. Neither type is suitable, because the filaments of the tubes are very delicate and burn out easily.

Studying the Diagram

Complete servicing information will be furnished at no charge when you want it to carry out the Practical Training Plan. Simply write NRI giving us the manufacturer's name, the model number of the receiver, and the number and type of each tube used. Also mention that you are using the set for the Practical Training Plan.

Fig. 1 is a diagram of a typical five-tube a.c.-d.c. receiver. The first step in carrying out the Training Plan on this set would be to trace the signal from the loop antenna to the speaker. The signal is picked up by the loop and fed to the grid of the 12SA7 mixer tube. In this stage it is mixed with the local oscillator signal, and the resulting beat frequency is fed to the primary of the i.f. transformer. The primary is inductively coupled to the secondary and an i.f. signal is induced in the secondary winding of this transformer, and the signal is then applied between the grid and the cathode of the i.f. tube. Similarly you can trace the signal through the detector, the output stage, and on to the speaker.

Next, trace out the power supply circuits. Find out how the plate and the screen of each tube receives its operating voltages. Try to visualize the components that could break down, and remove the operating voltage from the plate or the screen of one of the tubes. For example, suppose some part broke down and removed the plate voltage from the 12SK7. If all other voltages, including the screen voltage on this tube were normal, the only thing that could cause this trouble is an open in the primary winding of T_2.

Next, draw the circuit diagram. Do this on a large sheet of paper, using schematic symbols like those used on the original diagram, and indicate the electrical value of each part. As you reproduce the drawing, try to visualize the function of each part and circuit. Draw the power supply first, then draw each electrode supply circuit. Next, insert the condensers that keep the signal currents in the correct paths, and then add all special control circuits.

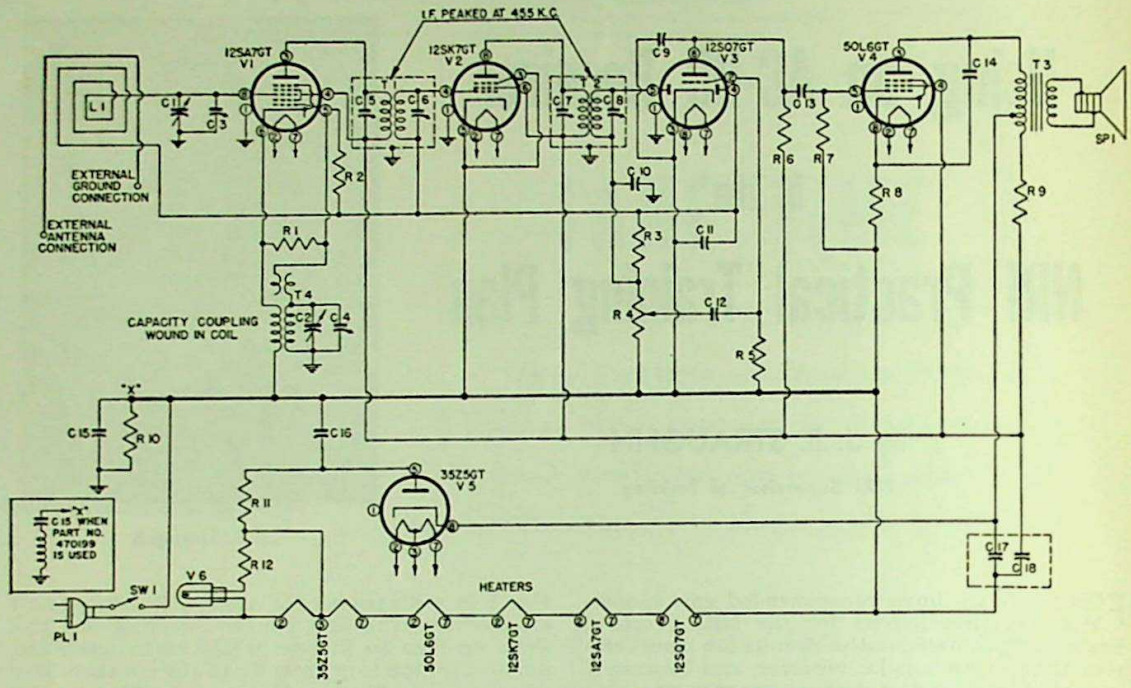


Fig. 1. Schematic of Emerson Model 519 (Typical AC-DC Receiver).

PARTS LIST

C1, C2	Two-gang variable condenser	L1	Loop antenna
C3	Trimmer, part of variable condenser	R1	22,000 ohms, ¼ watt
C4	Trimmer, part of variable condenser	R2	15 meg., ¼ watt
C5, C6	Trimmers, part of first i-f x-former	R3	3.3 meg., ¼ watt
C7, C8	Trimmers, part of second i-f x-former	R4	.5 meg. volume control
C9, C12	.002 mfd., 600 volt condenser	R5	15 meg., ¼ watt
C10	220 mmf. mica condenser	R6, R7	.47 meg., ¼ watt
C11	.05 mfd., 400 volt condenser	R8	150 ohms, ½ watt
C13, C14	.02 mfd., 400 volt condenser	R9	1000 ohms, 1 watt
C15	.2 mfd., 200 volt condenser	R10	.22 meg., ¼ watt
C16	.05 mfd., 400 volt condenser	R11	15 ohms, 1 watt, w.w.
C17, C18	30-50 mfd., 150 volt dual electrolytic	R12	10 ohms, ½ watt

Use a tube chart to identify the various tube socket terminals. It would be worth while to make a tube socket connection diagram to help familiarize yourself with the various socket connections.

Finally, identify the various stages on the receiver itself, and then identify the various parts used in the set, referring to your enlarged drawing as you identify the individual parts. Do not use pictorial wiring diagrams. Most manufacturers do not supply this type of diagram and therefore it is important that you learn how to work from a schematic diagram.

Electrode Continuity Tests

Now make a continuity test of each electrode circuit with an ohmmeter by connecting one ohmmeter probe to a tube socket terminal and the other on the correct power supply terminal. For example, check the plate circuit of the 12SA7 tube by placing one probe of the ohmmeter on the No. 3 pin of the 12SA7, and the other probe on the cathode (the No. 8 pin) of the 35Z5. Refer to the circuit diagram to see what the resistance should be. In making this test you will have the resistance of the primary winding of T_1 in the circuit, also resistor R_9, and a portion of T_3. The resistance of the primary of T_1 will probably be less than 20 ohms. The primary winding of the output transformer may have a resistance of about 200 ohms, whereas R_9 has a resistance of 1000 ohms. Therefore the reading between the plate of the 12SA7 and the cathode of the 35Z5 will be slightly over 1000 ohms.

In the same way you should check the continuity

from the screen of the 12SA7 back to the cathode of the rectifier tube. Also check between the plate of each of the remaining tubes and the cathode of the rectifier, and also between the screen of the 12SK7 and the 50L6 and the cathode of the 35Z5.

Besides checking the continuity in these circuits you should check the continuity between the grid and the cathode of each of the tubes back to the negative side of the power supply. In this receiver you can use the set side of the on-off switch as B—, or check the continuity to the negative leads of the filter condenser, since the chassis is not an electrical part of the circuit. Again, in taking each measurement, look at the diagram to estimate what the resistance reading should be. If you do not have a commercially manufactured multimeter to check continuity, use your NRI Tester.

The next step is to check the individual components in each electrode supply circuit. For example, in the plate circuit of the 12SA7, first check the primary resistance of T_1. In most receivers a resistance of between 15 and 20 ohms is normal. Next check the resistance of the portion of T_3 that is used as a choke. The resistance will be low, probably less than 250 ohms. Finally check R_9.

Carry this procedure out in all the electrode supply circuits and compare each reading with the diagram.

As an additional test you can check each resistor with an ohmmeter and compare the reading you obtain with the value listed on the diagram. Remember that some variation is to be expected.

Many resistors in the set will have a tolerance of 20%, and the accuracy of an ohmmeter is seldom better than 5%, so the measured value may vary as much as 25% from the value indicated on the diagram. Now check each coil for continuity.

After you have carried out these tests, check across the B supply and see if there are any shorts in the set. You can do this by connecting one probe of your ohmmeter to the cathode of the 35Z5 and the other probe to B—. Note the reading and then reverse the connections to your ohmmeter and take another resistance reading.

The higher of the two readings is the correct one to use and represents the leakage resistance of the filter condensers. If you should obtain a low resistance reading or zero reading it indicates a short; in this particular case the short would be in the input filter condenser C_{17}.

Measure the Electrode Voltages

You may use either a commercially manufactured voltmeter or your NRI Tester to check the operating voltages throughout the receiver. Connect the negative lead of the meter to B— and then connect the positive lead to the electrode under test. Start with the 12SA7 tube and connect the positive lead to the No. 3 pin of this tube and measure the plate voltage. Record the plate voltage of this tube and then move the lead over to the No. 4 pin of the tube and check the screen voltage.

Similarly you can check the plate and the screen voltages on the remaining tubes. It would also be worth while to check the cathode voltage on the 50L6, since the cathode will be above B— in potential.

Measure the output voltage of the rectifier tube by connecting the negative lead of the tester to B— and the positive lead to the No. 8 pin of the 35Z5. Notice that this voltage is somewhat higher than the plate and screen voltages of the tubes. The difference is due to the drop in the filter circuit.

When taking voltage measurements, first use a high range on your tester. In an a.c.-d.c. set, you should not run into voltages in excess of 150 volts. Make sure that the range on your tester is capable of measuring voltages at least this high. After you have once obtained a reading, you might be able to switch the voltmeter to a lower range, but to avoid the possibility of damaging the instrument you should always use a high range first until you find out approximately how much voltage is present in the circuit.

After measuring the plate and screen voltages on the various tubes, if you are using a high-resistance meter, you can probably also measure the grid voltage. If you have a strong local station tuned in you might be able to detect a small voltage on the grids of the 12SA7 and the 12SK7 tubes due to the a.v.c. However, if you can't measure this voltage do not be concerned about it, it is probably because your meter detunes the circuit and the a.v.c. voltage disappears.

Locating a Dead Stage

A dead stage in a receiver can be located quickly by means of a circuit disturbance test. You can perform this test on your receiver by starting with the output tube and working towards the antenna. With the set turned on and the volume control turned to the "full on" position, first touch the grid of the 50L6 output tube, using your finger or a screwdriver. This should produce a click or noise in the speaker. If it fails to do so you have a defect either in the power supply, the output stage, or the speaker. You can isolate the trouble further by checking the operating voltages on the 50L6. If you have normal operating voltages, the power supply is operating and the trouble is caused by a speaker defect or a

defect in the 50L6 stage. You can further isolate the trouble by trying a new 50L6, by checking the individual components used in this circuit, and by checking the speaker.

The next step in the circuit disturbance test, assuming you obtained a click or noise when you touched the grid of the 50L6, would be to touch the grid of the 12SQ7. This usually results in a loud humming or buzzing sound in the speaker. If you obtain this hum or buzzing sound you can touch the center terminal of the volume control as an additional check on the audio system. Again you should obtain the same loud humming or buzzing sound. If you fail to obtain it when you touch the center terminal of the volume control, but obtain it when you touch the grid of the 12SQ7, it would indicate that coupling condenser C_{12} is open.

You can carry out the circuit disturbance test in the same way throughout the remaining two stages. You should be able to isolate any defect to one stage without much trouble.

After trying this test on your receiver, introduce a defect in the set and then use the circuit disturbance test to isolate the trouble to one stage. Try disconnecting C_{13} from the plate of the 12SQ7 and then perform the circuit disturbance test to see if you can isolate the trouble to one stage. Also demonstrate the effect of disconnecting C_{12} from the center terminal of the volume control.

You can introduce similar defects in the 12SA7 or 12SK7 stages. A simple way to introduce a defect into either of these two stages would be to disconnect the B+ from the screen of one of the tubes, or disconenct the lead going from the plate to the i.f. transformer. After you have introduced the defect, use the circuit disturbance test to find the dead stage.

A signal generator can be used in more or less the same manner to isolate the trouble to one stage. Using a signal generator involves feeding a signal into the set starting with the output tube and working towards the antenna. You would feed an audio signal into the grid of the 50L6, also an audio signal would be used in the grid circuit of the 12Q7. In the 12SK7 stage you would use a 455-kc. signal (or whatever the i.f. frequency of your receiver may be).

When you come to the 12SA7 stage, first feed a 455-kc. signal into the grid of the tube. If this signal comes through the set, tune the receiver to the high end of the band and set it at about 1500 kc. Then feed a 1500-kc. signal into the grid of the tube. If the 455-kc. signal gets through but the 1500-kc. signal fails, it would indicate that the oscillator is not operating.

If you have a signal generator available, use it to demonstrate this technique for checking the local oscillator stage in your receiver. As a test, use a small piece of wire to short together the rotor and stator of the oscillator section of the tuning gang and use your signal generator to find the defective oscillator stage as described above.

A signal tracer may also be used to locate the dead stage in the receiver. The proper procedure is to start at the antenna and work through to the speaker. The receiver is tuned to the frequency of some local station and you then check at the grid of the first stage (the 12SA7) by tuning your signal tracer to the same frequency to see if the signal is picked up. Check at the plate of the 12SA7 for the amplified signal. If this signal is present, tune your signal tracer to the i.f. frequency. You should be able to pick up the signal again. If not, the oscillator is not operating.

If the i.f. signal is present at the plate of the 12SA7, follow it on through the i.f. stage to the second detector, and then use your signal tracer as an audio tracer to follow the signal from the second detector on through to the speaker.

Try your signal tracer (if you have one), on the receiver and introduce a defect in the set. Then use the signal tracer to locate the defective stage and the defective component.

WARNING—Do not short out any electrode supply circuits when introducing these defects in the receiver because you are likely to burn out the rectifier tube or damage some other components. Although it will not harm the receiver, do not remove any of the tubes from the set. The heaters of the tubes are connected in series, and if you remove any one of the tubes the series string will be open and the set will be completely dead.

Incidentally, it is well to keep in mind that whenever you encounter an a.c.-d.c. set in which none of the tubes will light, look for an open heater in one of the tubes.

Hum

In an a.c.-operated receiver that uses a power transformer you might run into 60-cycle or 120-cycle hum. Sixty-cycle hum can be caused by cathode-to-heater leakage in one of the tubes, or by hum pickup occurring somewhere in the audio system. A 120-cycle hum is always caused by a power supply defect. In an a.c.-d.c receiver, a half wave power supply is used, and poor filtering in the power supply will result in 60-cycle hum.

You can introduce hum in your receiver quite easily. Connect a condenser (.01 to .05 mfd.) between the grid of the 12SQ7 and the ungrounded

side of the volume control. This is an example of what 60-cycle hum sounds like.

You can also introduce hum in the receiver by disconnecting the output filter condenser. (In Fig. 1 this is C_{18}.) However, this condenser is used as a by-pass condenser, and disconnecting it might cause the set to oscillate.

Hum in a receiver of this type is usually caused by defective filter condensers, cathode-to-heater leakage in one of the tubes, or an open grid circuit. Try disconnecting one of the filter condensers, and if you can introduce hum in the set in this way, use a test condenser having a capacity of about 30 mfd. and rated at 150 volts. First try connecting it across the output filter condenser. You can do this by connecting the negative lead of the test condenser to B— and the positive lead to the screen of the 50L6 output tube. If the hum disappears, the output filter condenser is defective. If the hum remains, the input filter condenser is probably defective. Disconnect the test condenser, and, without discharging it, connect it directly between B— and the No. 8 pin of the 35Z5. If this stops the hum, the input filter condenser is causing the trouble.

Try to introduce hum by disconnecting the lead from the loop that goes to the a.v.c. lead. This hum is usually present only when a station is tuned in. If you can introduce hum in this manner, try to isolate it to one stage.

Oscillation and Motorboating

It might be difficult to introduce oscillation and motorboating in an a.c.-d.c. receiver. Usually the output filter condenser is used as a by-pass condenser on the i.f. and mixer stages. However, in some sets a voltage-dropping resistor is used in the screen circuit of one of the tubes, and in these receivers a screen by-pass condenser will be used. You should be able to introduce oscillation by disconnecting this by-pass condenser.

You can usually introduce oscillation and/or motorboating by disconnecting the output filter condenser, although it might introduce hum as well. Try it and see if you can demonstrate this effect. Remember when you run into this complaint in an a.c.-d.c. receiver the first thing to check is the condition of the filter condensers.

Noise

A certain amount of noise will be present in any given receiver. Tune between two local stations and turn up the volume of your set. You will notice that there is some noise present, but when you tune in a local station the noise should disappear.

When the receiver is tuned between stations there is no a.v.c. developed, and the set operates at maximum sensitivity. Therefore any noise originating in the first tube, or noise signals reaching the antenna are amplified by the receiver and can be heard in the speaker. When you tune to a local station, considerable a.v.c. is developed. This reduces the sensitivity of the receiver and the noise is not given sufficient amplification to be audible in the speaker.

Sometimes considerable noise is caused when the volume control is rotated. This indicates that the control is defective. A small amount of noise can be eliminated usually by pouring a few drops of carbon tetrachloride on the volume control shaft and then rotating the control as the solvent runs down the shaft into the control. If the control is very noisy it should be replaced.

To introduce noise in a receiver such as shown in Fig. 1, hold a soldering iron on the plate socket terminal of the 12SA7 and melt the solder. With a pair of long-nose pliers, wiggle the lead going to the i.f. transformer until it is free, and then remove the soldering iron from the plate socket terminal and continue to wiggle the wire until the solder sets. This should give you a loose connection.

Now try to operate the receiver; jar the chassis. You should run into considerable noise and possibly the set will go dead intermittently.

After you have introduced this defect try to isolate it to one stage. The first step in this procedure is to turn the volume control to the minimum volume position which should cause the noise to disappear. This indicates that the noise is originating at some point between the volume control and the antenna. If the noise continues even with the volume control turned to the minimum volume position, it would mean that the noise is originating between the control and the speaker.

If you locate the noise between the volume control and the antenna, try to isolate the noise to either the 12SA7 or the 12SK7 stage. First, short together the two secondary terminals on the first i.f. transformer. This would effectively short the grid of the 12SK7 to the a.v.c. lead, and eliminate signal pickup in the grid circuit of the stage. This will stop the noise and indicates that it is originating either in the grid circuit of this stage, or at some point ahead of the grid circuit.

Now try shorting the grid of the 12SA7 tube to the a.v.c. lead. You will find that the noise continues. Now you have isolated the noise somewhere between the grid of the 12SK7 and the grid of the 12SA7. This means that the trouble is either in the 12SA7 stage or in the i.f. transformer, so by checking the tube, the components, and the connections in this circuit you should be able to find the defect.

It would also be worth while to introduce a defect in the plate circuit of the 12SK7 and the plate circuit of the 12SQ7 stages in the same way, and then isolate the trouble to one stage using the method described.

Distortion

Distortion is an audio defect and is frequently caused by improper operating voltages on one of the tubes in the audio section of the receiver.

The first step in locating this complaint is to check the operating voltages, particularly the bias.

To introduce distortion in your practice set, take a 50,000-ohm resistor and connect it in parallel with the coupling condenser used between the plate of the first audio stage and the grid of the output stage. (Condenser C_{13} in Fig. 1.) This should introduce considerable distortion. However, if it fails to do so you will have to reduce the size of the shunting resistor.

Once you have produced the desired distortion, check the operating voltages on the 50L6 output tube. Check the grid of the tube for a voltage across the grid resistor. You can do this by placing the positive probe of a d.c. voltmeter on the end of the resistor that connects to the grid of the tube, and the negative probe on the other end of the resistor. If the meter reads upscale it indicates that there is a positive voltage on the grid of the tube, and that there is definitely something wrong with the circuit. The positive voltage on the grid of the tube can be caused by two things—a leaky coupling condenser or a gassy output tube.

The first step to eliminate this trouble is to disconnect the coupling condenser. In your test receiver this would involve disconnecting both the coupling condenser and the resistor that you have connected in parallel with it, because it is simulating the leakage in the condenser. When you disconnect these two components, check again for a voltage across the grid resistor. You will find that there is no voltage—this means that the trouble is caused by a leaky coupling condenser, and the condenser should be replaced.

If there is still a voltage across the grid resistor, the output tube is gassy. In actual service work you might find either of these defects (i.e. leaky coupling condenser or gassy output tube) resulting in a positive voltage on the grid of the output tube, and causing distortion.

It would also be advisable to check the effect of leakage in the coupling condenser used between the center terminal of the volume control and the grid of the first audio stage. This is C_{12} in Fig. 1. You can shunt this condenser with a 25,000- or 50,000-ohm resistor and note the effect.

This particular type of distortion usually increases very noticeably when the volume control is advanced.

When you check the operating voltages on the 50L6 you will find that they are normal. In some cases you might find that the plate voltage on the 12SQ7 has varied somewhat, but a check of the value of R_6 will indicate that this resistor has not changed value; therefore it is likely that something is upsetting the bias on the tube.

Because of the high resistance used in the grid circuit, it is very difficult to check the actual bias on the tube. The usual procedure is to check the resistor in the grid circuit with an ohmmeter, or replace it. If the distortion continues, replace the coupling condenser used between the center terminal of the volume control and the grid of the 12SQ7. If the trouble persists, you should try a new 12SQ7.

Introduce this defect in your receiver to note the effect on the performance of the set, and check with your voltmeter to see whether or not the change in the grid voltage on the 12SQ7 tube can be detected.

As an additional test, introduce distortion in your receiver by increasing the size of the cathode bias resistor in the output stage. If this resistor is shunted by an electrolytic condenser, both the condenser and the resistor should be removed from the circuit and replaced by a resistor about ten times the size of the original cathode resistor. Turn the set on and note the distortion produced. Check the operating voltages throughout the audio section of the receiver to locate the circuit in which the defect has occurred. Use your ohmmeter to check the parts values and you will find the cause of the

increase in value of the cathode bias resistor.

There are other defects that can occur which will upset the operating voltages, but it is not safe to introduce them because, by so doing, the rectifier tube or some other component might be damaged. For example, in Fig. 1, a leakage in C_{14} would cause distortion. This would increase the bias on the 50L6 output tube. Of course, a check of the operating voltages would show that the cathode voltage was considerably above normal. An ohmmeter check of the cathode bias resistor would reveal that its value was normal, and a check of C_{14} would show that the leakage was in this condenser.

Distortion may also be caused by a defective loudspeaker. The speaker voice coil might be off center or the cone might have come unglued. It is not practical to try to demonstrate these defects on an a.c.-d.c. receiver, so you will have to wait until you run into this defect to see what it sounds like.

You can check the cone of the speaker to see whether or not it has come unglued or torn simply by examining it. To check the speaker voice coil to see whether or not it is off center, gently push the speaker cone in and out. If the voice coil is off center you'll be able to feel the coil scraping as you push the cone in and out, and you'll probably also be able to hear a scraping sound. In most cases there are no provisions made for recentering the voice coil on small speakers such as found in a.c.-d.c. receivers; when off center they must be replaced.

Distortion is a very common complaint, and the various defects pointed out are the ones most commonly encountered. You should introduce these defects in your test receiver to see exactly how they sound and also to give you practice in locating them, because you will meet them often.

Weak Receiver

In some sets you'll find a resistor in the cathode circuit of the mixer, i.f. stage, or one of the audio stages. In the mixer and i.f. stages this condenser will be by-passed, and in some cases in the audio section a by-pass condenser will also be used.

If the by-pass condenser in the mixer or i.f. stages opens, there will be a very noticeable reduction in the gain of the receiver. If your set uses a resistor and by-pass condenser in the cathode circuit of either of these two tubes, try disconnecting the condenser to note the reduction in volume.

If your set is similar to the circuit shown in Fig. 1, try inserting a resistor in the cathode circuit of the i.f. tube. A 150-ohm resistor should be satisfactory. By-pass this resistor with a .01-mfd. condenser and then check the performance of the receiver. Now disconnect the by-pass condenser from the circuit and notice the drop in volume. Try to isolate this defect to one stage.

In the cathode circuit of the output stage you'll probably find a cathode bias resistor. If this resistor has a by-pass condenser connected across it, disconnect the condenser and note the drop in volume. If no by-pass condenser is used, try connecting one across the resistor and notice the increase in volume. In the cathode circuit of the output tube an electrolytic condenser will be used as a by-pass condenser. If you're adding one to check the effect, use a 20-mfd. condenser rated at about 25 volts.

In some receivers this condenser is left out to introduce degeneration in the output stage and to improve the quality.

Low Q in a resonant circuit can cause weak reception. Try inserting a 100-ohm resistor in the circuit between a coil in one of the tuned circuits and the tuning condenser. In the circuit shown in Fig. 1, the resistor would be introduced in the circuit between the lead from the loop antenna and the tuning condenser. You could also lower the Q of one of the i.f. transformers by shunting it with a 10,000-ohm resistor. For example, you can shunt the primary winding of T_2 in Fig. 1 by connecting a 10,000-ohm resistor between the plate of the 12SK7 and the screen of this tube.

If the set stops playing entirely, increase the size of the resistor. You'll notice that with the resistor connected across this way the trimmer peaks very broadly, and the gain of the receiver is reduced considerably.

Locating the defective stage in a weak receiver is sometimes quite difficult. The easiest way to locate the stage causing the trouble is with a signal tracer. However, when a signal tracer is not available, a circuit disturbance test, a check of the operating voltages, and shunting various coupling condensers and by-pass condensers will be helpful in finding the stage causing the trouble.

Intermittent Defects

It isn't possible to introduce intermittent defects in a receiver so you'll have to get your practical experience when you encounter a receiver with this particular defect for servicing. When you run into this trouble you should try to localize it to one stage, then if necessary, check the individual parts in that stage one at a time. There usually aren't many components, and it shouldn't take long to find the defective part.

In servicing intermittent receivers, frequently you can find the trouble by turning the set upside down on a table or workbench, and with the receiver operating, pull and wiggle the

various parts and leads in the set. If you discover that when you pull or wiggle a certain part you can make the set cut out or play at will, the part is defective and should be replaced. If pulling a certain lead causes the set to cut out look for a loose connection or a broken lead.

Sometimes taking two sets of voltage measurements is helpful. If the set cuts out and remains dead for some time you can take one set of voltage measurements when the receiver is playing properly, and the other set of readings when the receiver cuts out. By comparing the two sets of readings you may notice a variation in a particular circuit—look for a defect in that circuit.

If the receiver cuts out completely and remains dead for some time you may be able to isolate the trouble to one stage by means of a circuit disturbance test. Once you have located the defective stage you can then concentrate on that stage.

When the intermittent defect shows up within the first two or three minutes of operation, look for a defective connection or a condenser that's opening intermittently. Coupling condensers such as C_{12} and C_{13} in Fig. 1 cause trouble of this type.

When the set operates for three or four minutes satisfactorily and then begins to cut out it's usually because of an intermittent defect occurring in some part that takes three or four minutes to heat up. Resistors, particularly cathode bias resistors, cause trouble of this type. The intermittent defect in this case can frequently be located by voltage measurements. For example, if R_8 were opening (Fig. 1) you'll notice that the voltage on the No. 8 pin of the 50L6 would go up to a high value when this resistor opens.

In a.c.-d.c. receivers you'll frequently find that when you turn the set on the tubes light up, and then after a short while they all go off. Then light up again and go off. This process will continue and is caused by an intermittent heater in one of the tubes. The defect can be located by checking the heater voltage across the tubes one at a time with an a.c. voltmeter.

Refer to Fig. 1, and start by checking the heater voltage on the 35Z5. This is done by connecting the a.c. voltmeter between the No. 2 and the No. 7 pins. A voltage of about 35 volts is normal, and when the tubes go out, the heater voltage should drop to zero which shows that the tube is good. If the heater voltage goes up to a value equal to the line voltage, the heater of the tube is opening and the tube should be replaced. The same tests should be performed on each of the tubes, and by waiting until the tubes go out and then observing the reading on the meter you should be able to find the defective tube quickly.

Intermittent defects in the receiver are probably the most difficult type of defect to find. In some cases you'll find that when you remove the receiver from its cabinet it will play indefinitely without any trouble. However, as soon as the set is put back in its cabinet, it will play for a while and then begin to cut out intermittently.

Defects of this type are always due to heat. Some part is breaking down as it heats up, but when the set is operated after removing it from its cabinet the heat developed by the receiver is carried away, and the defective part doesn't get hot enough to break down. Defects of this type can be located by placing a box or a blanket over the receiver to allow it to heat up. However, a certain amount of care must be observed when doing this, otherwise other components may become hotter than normal and become damaged. If you can get the set to cut out in this way, you can usually remove the box or blanket and the set will remain dead for a reasonable length of time, and you can proceed to isolate the trouble to one stage.

Alignment

It is comparatively easy to align an a.c.-d.c. set if you have a signal generator available, but if you don't it is not advisable to try. The best thing to do is wait until you can obtain a signal generator and then carry out the alignment procedure on the receiver as outlined here.

To align a receiver of this type the first thing to do is peak the i.f. transformers at the correct frequency. In Fig. 1 the i.f. transformers are peaked at 455 kilocycles.

To peak the i.f. transformers, first connect the output meter between the plate of the 50L6 output tube and ground. If you do not have an output meter an a.c. voltmeter can be used.

Simply connect one lead from the voltmeter directly to B—, and the other to a .05-mfd. condenser rated at 600 volts. Connect the other end of this condenser to the plate of the 50L6. The voltmeter should be set on a range where it can read voltages up to about 100 volts.

Next, connect your signal generator to the receiver. You can do this in a set that uses a loop antenna by wrapping a piece of wire around the antenna about two or three times and then connecting the signal generator to one end of the wire. The other end of the wire is simply left free. If the set has an outside antenna you can connect the signal generator to the antenna terminal.

The signal generator is then set to 455 kilocycles. A modulated r.f. signal is used. The output of the signal generator is turned up until you have a small indication on the meter; then

reduce the range of the meter. Use the lowest convenient range of the meter that you can. As you align the set, the meter reading will increase and eventually reach a point where it will go off scale. Instead of using a higher meter range, reduce the output from your signal generator.

Now you are ready to align the i.f. transformers. The output i.f. transformer, T_2 in Fig. 1, should be adjusted first. If the two trimmers on the transformer can be identified, adjust the secondary first; and then the primary. The trimmers are peaked for maximum reading on the meter.

Once you've peaked the output transformer peak the adjustments on the input i.f. transformer. Again, if you can identify the trimmers, peak the secondary first and then the primary. If the trimmers cannot be identified do not be too concerned because it is not very important which of the two is peaked first.

After you have peaked the input i.f. transformer, go back to the output i.f. and recheck your adjustments, and then check the adjustments on the input i.f. transformer again.

This completes the alignment of the i.f. transformers. You should now adjust the mixer and oscillator stages. To do this tune the set to the high end of the band. The best thing to do is to pick out a frequency around 1600 kilocycles on which there are no local stations operating. Tune the set to this spot on the dial and then set your signal generator at this frequency. Once you've done this, adjust the oscillator trimmer to make the dial read correctly. Next, adjust the mixer trimmer for maximum output.

In a receiver such as shown in Fig. 1 no further adjustments are necessary. The oscillator section of the tuning condenser has specially shaped plates so that the oscillator will track with the mixer, providing the i.f. transformers are peaked at the correct frequency. However, in some sets, particularly older receivers, there may be an oscillator padder condenser. In aligning these receivers the procedure is exactly

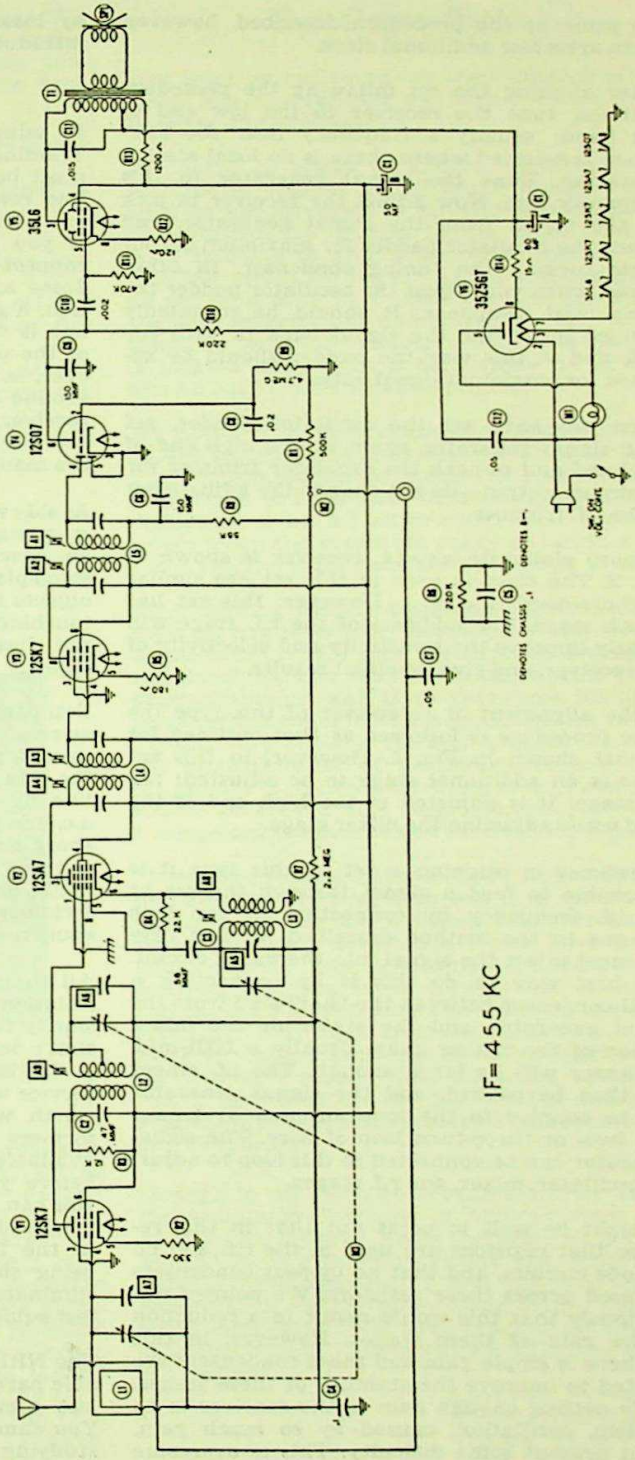


Fig. 2. RCA Model 9X642. Typical AC-DC set with RF stage.

the same as the procedure described, however, there are a few additional steps.

After aligning the set following the procedure outlined, tune the receiver to the low end of the band; usually a frequency near 600 kilocycles is selected where there is no local station operating. Tune the signal generator to this frequency also. Now adjust the receiver to pick up the signal from the signal generator, and adjust the oscillator padder for maximum output while rocking the tuning condenser. In other words, when you adjust the oscillator padder the signal will disappear. It should be repeatedly retuned by tuning the signal back in with the dial, and in this way the padder should be adjusted for maximum signal output.

Once you have set the oscillator padder, set your signal generator again at the high end of the band and re-peak the oscillator trimmer for maximum output—do not change the adjustment of the r.f. trimmer.

A more elaborate a.c.-d.c. receiver is shown in Fig. 2. The circuits used in this set are similar to those used in Fig. 1. However, this set has an r.f. stage. The addition of the r.f. stage will greatly improve the sensitivity and selectivity of the receiver, and give excellent results.

In the alignment of a receiver of this type the same procedure is followed as that outlined for the set shown in Fig. 1. However, in this set there is an additional stage to be adjusted; the r.f. stage. It is adjusted at the high end of the band while adjusting the mixer stage.

Sometimes in aligning a set of this type it is impossible to feed a signal through the set at the i.f. frequency by connecting to the loop antenna in the method described. In this case you must inject the signal into the mixer circuit. The best way to do this is by connecting a small condenser between the "hot" lead from the signal generator and the stator of the mixer section of the tuning gang. Usually a .0001-mfd. condenser will be large enough. The i.f. stages can then be peaked, and the signal generator can be coupled to the loop antenna by means of a two- or three-turn loop of wire. The signal generator can be connected to this loop to adjust the oscillator, mixer, and r.f. stages.

It might be well to point out that in this receiver that resistors are used in the r.f. and i.f. cathode circuits, and that no by-pass condensers are used across these resistors. We pointed out previously that this would result in a reduction in the gain of these stages. However, in this set there is ample gain and these condensers are omitted to improve the stability of these stages. While getting enough gain in the receiver is no problem, oscillation, caused by so much gain, might present some difficulty. This is overcome by inserting these resistors in the circuits to introduce a certain amount of degeneration.

Precautions

In using an a.c.-d.c. receiver for the Practical Training Plan, there are a few precautions that must be observed. First, one side of the power line connects directly to B— in a receiver of this type. Therefore, the set must not be grounded. If you ground the receiver you are likely to connect a short directly across the power line. Some a.c.-d.c. receivers have a ground connection. A ground may be connected to this terminal, but it will add very little to the performance of the set, and therefore it is best left off. However, in no circumstances should you connect a ground connection to the chassis of an a.c.-d.c. receiver, or connect it at any point to an a.c.-d.c. receiver unless a ground terminal is provided by the manufacturer.

Avoid working on an a.c.-d.c. receiver while standing on a concrete floor. If you are working on a set in the basement you should have a wood platform. Also avoid touching any grounded objects such as water pipes, radiators, etc., while touching the chassis of an a.c.-d.c. receiver. Keep the chassis of the set away from any grounded object.

You cannot use a.c.-d.c. operated test equipment on receivers of this type. A.C.-operated equipment using a power transformer may be used, because the equipment will be isolated from the power line by the transformer. However, if you use a.c.-d.c. test equipment you're likely to place a short directly across the power line when you connect it to the receiver. By doing this you might burn out a fuse in the house, or you might seriously damage either the receiver or the test equipment.

All these precautions are unnecessary if a line isolation transformer is used. This transformer simply consists of a one-to-one ratio transformer that's designed to isolate the equipment from the power line. Since most of the receivers you will service will be a.c.-d.c. operated, it would be well worth while to purchase one of these transformers from a radio parts supply house. (Not available through NRI.) If possible, buy one before you start the Training Plan, and then you can use the transformer with the Training Plan and you'll have it available for service work in the future. It will avoid the possibility of being shocked while working on the set, and eliminate the possibility of accidentally damaging test equipment.

The NRI Practical Training Plan is a very valuable part of your Course. If you omit it you have lost some very valuable practical experience. You cannot learn how to do service work from studying your lessons alone. You must obtain

practical experience along with your studies. The Practical Training Plan offers you the opportunity of obtaining practical experience that might take years to obtain in the service field.

———*n r i*———

Wife: "The maid quit. She said you spoke to her insultingly over the phone."
Hubby: "Ye gods! I thought I was talking to you."

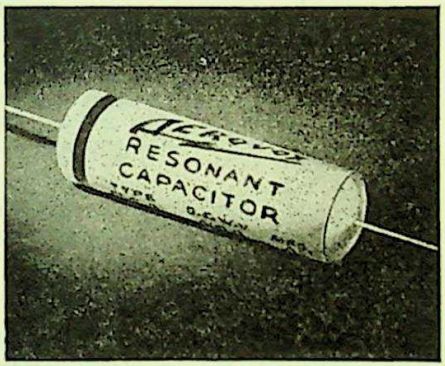
———*n r i*———

It was two days after a big party when two friends met on the street.
"Well, old man," said one of them, "how did you get along after I left you the other night? Did you get home allright?"
"No," was the reply, "a policeman saw me and he took me to the station and I had to spend the night in jail."
"You sure were lucky," said the first. "I got home!"

———*n r i*———

"Well, Peggy," said the neighbor, "and how do you like your new governess?"
Peggy thought a moment and then said: "I half like her and I half don't like her, but I think I half don't like her the most."

———*n r i*———



Resonant Paper Tubulars Improve I.F. Filtering

New type Resonant Capacitors made available by Aerovox Corp., New Bedford, Mass., act as series resonant circuits, effectively by-passing undesirable IF signals between 425 and 485 kcs. Since IF amplifiers in modern receivers have very high gain, it becomes increasingly difficult to use regular bypass capacitors to eliminate all traces of unwanted signals. Adequate elimination is said to be accomplished with resonant capacitors. These capacitors are made by winding sections in such manner as to increase the inductance in same. By properly placing the tabs, the section inductance can be controlled so that the capacitor will be resonant in the IF band.

Our Cover Photo

This issue, on our cover, we show another of the many fine photographs we have received from students and graduates.

Mr. Lloyd H. Smith of Vonore, Tennessee, got into Radio without giving much thought to it until he was attracted by an NRI advertisement. He enrolled. He studied in his spare time as most students do and, after some months, took in a few radios for repair. As his business grew, he set up a shop in a small room in his home. He soon outgrew this and moved his shop downtown. He owns the building in which his business is located and places a high value on it. This was all built from a small beginning.

Mr. Smith is another example of what hundreds of NRI students and graduates are doing. It takes first, determination to study—to concentrate—to stick to it regardless of obstacles and little disturbances we all experience. Soon the time comes when the student is ready to tackle a few radio receivers. He puts his knowledge to work.

After making various tests and adjustments he finds he has been able to overcome the trouble in the receiver. He gets the thrill of seeing the results of his own efforts. He takes pride in his accomplishment and from that time on, if he gives serious thought to his opportunities, he can expand very rapidly. Here is a quotation from the original letter of testimony received from Mr. Smith. "I wanted something to do. I saw your course advertised in a magazine and I enrolled. I completed the course and received my diploma.

"I repaired several radios before I had completed my training. My first shop was in a small room in my home. As my servicing jobs increased, I moved my shop downtown. I now have a well equipped shop, good test equipment and own the building my shop is in. I repair all makes of radios, also FM, and have started to do television servicing. I average from two hundred to five hundred dollars each month on my radio work spare time. I repair other electrical equipment too. I find that the 90 day service and parts guarantee is most satisfactory. It gains customers and confidence.

"I work in my radio shop each morning, and at the Aluminum Company of America from 2 till 10 at night. My wife keeps the radio shop in the afternoon. She takes in radios and collects on those I have repaired. I find the NRI course beneficial in all my radio work. If my business keeps increasing I will have to spend all my time repairing radios. I am dealer for RCA and Emerson radios."

LLOYD H. SMITH
Smith's Radio Service
Vonore, Tenn.

Read How NRI Graduates Are Forging Ahead in Radio and Television

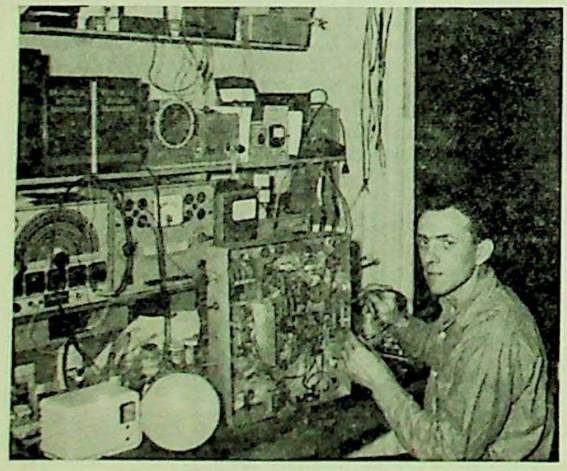
Has Amateur Radio Station and Spare-Time Service Business

"My new amateur call letters are W4RUG. In addition to activities in our local Amateur Club, I spend one night each week as Staff Sergeant in charge of communications for 'A' Battery, 104th AAA AW Bn., Alabama National Guard.

"My spare hours are filled with servicing auto and home radios for my neighbors. This has been netting me approximately $10 per week. I attribute my ability to participate in these activities entirely to the training NRI has given me. Thanks a million."

WILLIAM V. YOCUM,
217 Oak Grove St.
Florence, Alabama.

n r i



Small Part-Time Business Takes In $1000 in One Year

"I sure feel proud of my diploma. I can't say enough for the NRI Course. It was very interesting and easier than I thought it would be. I only regret that I did not take the NRI Course years ago. I saw your ads and would just turn the page, saying I could never learn to fix radios. But now I have found that it only takes a little effort.

"I have a small part-time shop on my sun porch and in a year I took in around $1,000. I still use my NRI Tester for all tests that I make. It surely is easy to find the trouble in a radio from the methods I learned."

FRANK S. TUCKER,
401 Warwick Road,
Hilton Village, Va.

n r i

Earned Money While Training—Now Doing Well

"Long before completing my course I was fixing radios, earning money to pay for my test instruments. Now I have all the work I can handle on a spare-time basis. Have serviced several Television receivers with excellent results.

"The NRI Experimental kits furnish a very good groundwork for learning the function of parts, the wiring and tracing of electrical circuits. NRI lessons are presented in a form easily understood and become an excellent reference."

GEORGE R. TAYLOR,
4321 Clarendon Rd.,
Brooklyn 3, N. Y.

Fully Qualified As Radio and Television Service Technician

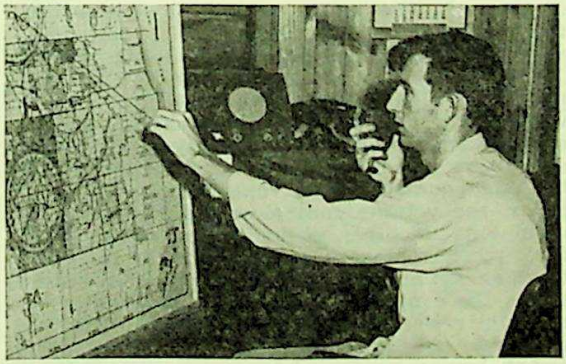
"I began earning money by servicing radios very early in my course. I feel that I received great benefits from the NRI experimental kits, and that they were necessary to familiarize me with layout of parts, wiring, voltages, etc.

"I am doing full time radio and TV servicing, including car radios, and at least six to ten TV sets each week. I do some work at home, and I also do contract labor for a shop, receiving 75% of my labor charges. I also sell radios, TV sets, and appliances on my own, buying them direct from wholesalers.

"The NRI course is wonderful and complete. It affords the opportunity to learn the basic theory and enough practical work so that you will not feel lost when you get into servicing. The rest comes from experience and further study. I now consider myself fully qualified as a Radio and Television Technician."

DANIEL B. MCDONALD,
2224 Meadowdale Ave.,
Los Angeles 31, Calif.

———*n r i*———



Holds Salaried Position Doing Television Work

"I hold a salaried position with Lichtman Bros. in Perth Amboy, N. J., doing Television work. Have been quite busy installing sets of all types. I find it very interesting work, especially when setting up antennas in rough areas where we encounter all types of interference. We cover wide areas here, sometimes traveling up to forty miles.

"At present I have one helper with me. In a short while I expect to be assigned to general repair work. With a little more practical work under my belt I expect to have my own shop.

"After about my 17th lesson I began fixing radios in spare time following my regular factory hours, and earned about $10 a week. I still do part-time jobs on TV and radio when time permits."

JOSEPH LASKIEWICZ,
100 Pacific Blvd.,
Cliffwood Beach, N. J.

———*n r i*———

Dispatcher and Radio Operator With Forestry Service

"My future looks very good in Radio and I owe it all to you. I am now employed with the Florida Forest Service as a Dispatcher and Radio Operator.

"I can never repay you for all that you have done for me. The Forest Service is well pleased with the work I do. I am proud to let others know that I am a graduate of NRI. Enrolling was the best decision I ever made. I would enjoy writing to anyone who thinks he would like radio."

BENSON E. BYRAM,
RFD 1, Box 601,
Orlando, Fla.

As space permits, from time to time, we plan to devote a page or two in NR-TV News to short success stories such as above. They are taken from testimonial letters we have on file. Photographs and letters of this kind are always greatly appreciated by us. We feel we should pass them on to our readers for the inspiration to be gained from a reading of them.

Choosing Substitute Replacement Parts

By WILLIAM F. DUNN
NRI Consultant

William F. Dunn

THERE will be many occasions in servicing radio and TV receivers when an exact duplicate replacement will not be available. Many parts are standard, and it is not necessary in all cases to use an exact duplicate replacement made by the original manufacturer. For example, when replacing a tube in a radio or a television set, you know that a similar tube type made by a different manufacturer will work just as well.

A large number of other part substitutions are possible as well as tubes. For example, resistors and condensers need not be purchased from the original supplier. A .05-mfd. condenser rated at 600 volts is the same condenser regardless of who made it. There may be some variation in size or shape, there may even be some small electrical variation, but this is unimportant. To replace a resistor, simply obtain a replacement resistor having approximately the same resistance and wattage rating as the original.

These substitutions are more or less obvious. Resistors, condensers, and tubes are usually bought from wholesalers who specialize in replacement parts. However, there are components in radios and TV receivers which should be replaced by parts that are their exact duplicate, when they are available. For example, suppose the antenna coil in a three-band receiver opened. If the receiver were made within the last few years, it is possible that the distributor of that particular brand will have an exact duplicate replacement coil on hand. Use it by all means. It is inadvisable to install a universal replacement antenna coil if the exact duplicate replacement is obtainable.

In this article we are primarily concerned with replacing parts, whose values are critical, when exact duplicate replacements are not available.

Controls

When we speak of controls in a receiver, we usually mean the volume control and the tone control. In a Television set, besides a volume control, and sometimes a tone control, there may also be a brightness control, a contrast control, and a horizontal and vertical hold control, etc.

If the control is a single control, you need not obtain an exact duplicate replacement. You could determine from the manufacturer's diagram the size of the original control, and obtain a replacement from almost any wholesaler. However, there are a few things that must be considered.

When replacing the volume control in a receiver, it is essential that you obtain the same type of control. The exact resistance of the control is not so critical. For example, an audio type of control may have a value anywhere from .1 megohms to 2 megohms. The value can probably be varied anywhere between these limits without any noticeable effect upon the performance of the receiver, providing you obtain an *audio type* of control. If, however, you replaced the audio control with a control having a linear taper, the volume control would not vary the volume as smoothly as it did previously. Therefore, when replacing any control, first consult the diagram and determine the type of circuit in which the control is used, and if possible, determine the resistance. Then, order the replacement control by specifying the type of control required and the approximate resistance.

In some of the older radio receivers, dual controls were used. Replacements for these receivers are still obtainable, particularly the more popular

ones. But when an exact duplicate replacement is not available, it is quite possible to modify the circuit so that a standard replacement can be used.

Fig. 1 shows the dual volume control circuit used in the Philco Model 20 receiver. Notice that the section of the control on the left is used to vary the cathode bias on the two 24 tubes, and the section on the right varies the signal input to the antenna coil.

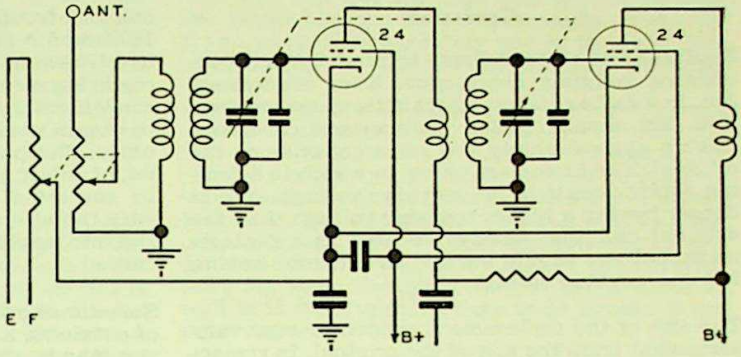


Fig. 1

The circuit can be modified as shown in Fig. 2. In this circuit, a fixed resistor has been installed between terminals E and F. The value of the fixed resistor should be equal to the resistance of this section of the original control. A single control has been installed to vary both the signal input to the antenna coil and the cathode bias on the tubes. The fixed resistor R has been installed in the cathode circuit to limit the minimum bias on the tubes.

In ordering a control of the type shown in Fig. 2, the resistance of the control is not too important; anything between 5000 and 15,000 ohms would be satisfactory. It is important, however, that you obtain an *antenna-C bias type* control.

There are several other types of dual controls that can be replaced by a single substitution. In selecting a substitution you should first study the circuit to determine the function of the two controls and to ascertain if the two controls are used in such a way that a single replacement can be substituted. It is emphasized that when selecting the replacement control, remember that the exact resistance usually is not too important, but it is important that the correct *type* of control be used.

When replacing "contrast," "brightness," and "hold" controls in TV receivers, a control having a linear taper should be used. Single controls can be replaced by standard replacements. However, many TV receivers use concentric controls. These controls actually consist of two separate controls built around a dual shaft and must be replaced with a part that not only has approximately the same value, but that also has a shaft whose length is approximately equal to that of the original. The shaft of a concentric control cannot be cut off like the shaft of a single control. Usually the distributor of the receiver will carry replacement controls having approximately the same electrical value and mechanical size of the original unit. However, as more and more TV sets are made, the chances are that in the future, it will be possible to make standard substitutions. When making these substitutions remember that the length of the shaft on the replacement control is important, and also that the replacement control must have approximately the correct resistance, but more important it must have the correct taper.

An example of where you might run into trouble would be in trying to install a dual control which was designed for use as a combination contrast and volume control in place of a dual control that is to be used as a horizontal and vertical hold control. You may find it possible to obtain a control that was designed for use as a contrast and volume control that has the correct resistance for use as a horizontal and vertical hold control. However, the replacement control that was designed for use as a volume control has an audio taper. This is not a linear taper, however. Therefore, when you try to use this control in one of the hold circuits, the action of the control would not be smooth. In other words, you would probably find that the adjustment of the control was very critical. This type of replacement is obviously unsuitable.

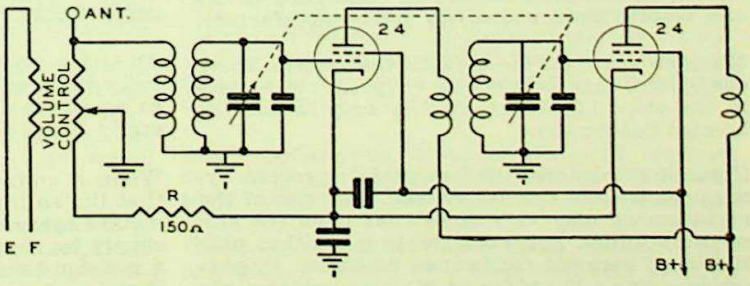


Fig. 2

Condensers

Replacement of condensers such as by-pass condensers, coupling condensers, filter condensers, etc., in a radio receiver offers little or no problem. You can usually find a replacement condenser having approximately the same capacity as the original. The important thing to watch in selecting replacements is the working voltage. A condenser having a higher working voltage than the original unit may always be used as a replacement, but you should not use a condenser having a lower working voltage.

The size of the replacement condenser may vary somewhat from the size of the original. In replacing filter condensers you can always use a condenser with a larger capacity. Manufacturers usually use the smallest possible size condenser in order to keep the cost of the set down. If you use a larger condenser, the filtering will be just that much more effective. Of course, the input filter condenser should not be increased several times the value of the original, because the initial surge through the rectifier (when the set is turned on) may be so high that the life of the rectifier tube will be shortened.

Coupling condensers can be replaced by larger ones without ill effect on the reception of the receiver. The size may even be decreased slightly without any noticeable effect, in most cases.

By-pass condensers are not critical. You can almost always vary the size somewhat (at least plus or minus 50%).

The same general rules apply in a TV receiver. Electrolytic condensers can be replaced by larger condensers having higher working voltages. In the video amplifier, larger coupling condensers may usually be used. But, sometimes difficulty will be encountered because the physical size of the condenser may be increased also; this in turn may increase the distributed capacity in the circuit and result in a reduction in the high-frequency response. In video circuits it is usually best to try to obtain a condenser as close as possible to the value and physical size of the original unit. However, if you must make some slight change in the size, do not be concerned if the end result (picture quality) seems satisfactory.

Many TV receivers use ceramic condensers. These condensers may be used as coupling condensers in the video i.f. stages, or they may be used as by-pass condensers.

Ceramic condensers used as plate or screen by-pass condensers are not critical. The size of the replacement may vary somewhat from the size of the original. For example, in a set that uses 1000-mmf ceramic condensers as screen by-pass condensers on the video i.f. stages, replacements can be made with 1500-mmf replacements without any trouble. You might even be able to use 1000-mmf replacements in a set that originally had 1500-mmf by-pass condensers. However, when replacing ceramic condensers used as the coupling condensers in the video i.f. stages, you should try to obtain condensers having the same electrical value. The physical size may vary slightly. This might affect the alignment of the set, but it can be corrected by realignment. However, if you vary the electrical size of the condenser you may run into trouble obtaining the correct i.f. response curve.

Sometimes you may be faced with the problem of obtaining a certain condenser whose electrical size may be quite critical. When you do not have the correct replacement available and do not have the time to obtain the correct replacement, or the correct replacement is not available, you can use two condensers in parallel to give you the desired electrical capacity. For example, suppose you need a .15-mfd condenser. You could connect a .1-mfd. condenser in parallel with a .05-mfd. condenser to obtain a total capacity of .15 mfd. Of course, as pointed out previously, in most cases where the original circuit uses a .15-mfd. condenser, either a .1 or .2-mfd. condenser should work satisfactorily. Since in a few critical circuits you may find that neither one of these substitutes is satisfactory, and if a .15-mfd. condenser is not available, you could obtain the correct capacity in the above manner.

Resistors

Replacing most of the resistors in a radio or TV receiver presents no special problem. All wholesalers carry large stocks of resistors. While they may not be able to supply you with the exact size you want, they can usually provide a suitable resistor with a value close enough to the size of the original.

You will find it necessary to make changes in many cases. For example, in servicing old radio sets, you may find a 50,000-ohm resistor. Manufacturers are now making the resistors in standard sizes and although 50,000-ohm resistors are not standard, 51,000-ohm resistors are. Certainly a small change such as this would not affect the performance of the receiver in any way.

The only place you are likely to run into difficulty with resistors is in replacing a resistor used as a voltage divider. However, even then it generally is not too big a problem.

When a voltage divider burns out it is seldom that the entire unit has burned out. Usually one section opens. You can repair the damaged unit simply by shunting the burned-out section with a resistor having a resistance equal to the unit that has burned out. You can then continue to use the original voltage-divider resistor.

Occasionally a voltage divider will develop an intermittent defect. One section may be opening intermittently. If you shunt this section with a resistor, the voltage divider will still continue to open intermittently, and this would cause considerable interference. When this situation is encountered you must replace the entire divider or completely destroy the defective section by cutting its wires with a knife or diagonals.

If an exact duplicate replacement is not available, sometimes you can find a voltage-divider type of resistor whose value is close enough to the original unit to be usable. However, when this is impossible, you can make up a voltage divider by using individual resistors, having the correct resistance and wattage rating, and connecting them in series.

Another special type of resistor that is frequently encountered is a ballast. If used, a ballast is usually in series with the heaters of the tubes in a radio or a TV receiver. Universal replacement ballasts are available that can be used as replacements for 90% of the ballasts used. Companies manufacturing replacement ballast tubes have catalogs available where the replacement for the various ballast types are listed. Most wholesalers have copies of these catalogs from which they can select for you a suitable replacement ballast.

Coils

Whenever a coil in the r.f., mixer, or oscillator circuits in a radio breaks down you should try to obtain an exact duplicate replacement. Contact the wholesaler who distributes the receiver in your locality to see if he has a replacement available.

If the wholesaler does not have an exact duplicate replacement you must use a substitute coil. There are universal replacement coils that will give reasonably satisfactory results in most cases. However, there are a few things that you should know about the coil.

Some manufacturers make replacement coils in two types. One type is designed for use in t.r.f. receivers, and the other for use in superheterodynes. Some manufacturers do not make separate types for t.r.f. receivers and superheterodynes.

When ordering a universal replacement coil, it is a good idea to specify whether it is to be used in a superheterodyne or in a t.r.f. receiver so that you will be sure to obtain the correct type in the event that the coil manufacturer does make separate types.

If it is necessary to replace one of the coils in a small t.r.f. receiver having only one r.f. amplifier stage, it is a good idea to replace both coils. Obtain a matched set of coils, and the chances are that you will not run into any trouble getting the tuned circuits to track properly. However, if you were to replace only one of the coils, you might have trouble caused by improper tracking.

If it is necessary to use a universal replacement coil in a superheterodyne receiver you may run into some trouble from improper tracking. By carefully aligning the set it may be possible to obtain reasonably good tracking across the broadcast band. The set may not track as well as it did originally, but there is not much that you can do about this. It is better to have the receiver working, even though it doesn't work quite as well as it did originally, than to be unable to use the set at all.

When you run into a situation where the receiver tracks very poorly, and you are unable to do anything about it by realigning the set, it is worth while to try a replacement coil made by a different manufacturer. Universal replacement coils made by different manufacturers vary somewhat, and where one coil might not track properly, another one might work out reasonably well.

You will find that some universal coils are shielded, whereas others are unshielded. If the original coil in the set was shielded, then a shielded replacement should be obtained. Similarly, if the original was unshielded, an unshielded replacement should be used.

Coils with adjustable cores are also available. Sometimes it is easier to get the set tracking when an adjustable type of coil is employed.

Aside from the coils in the r.f., mixer, and i.f. stages, you are not likely to run into any air-core coils in broadcast band receivers. However, in TV receivers you will find peaking coils. When it is necessary to replace a peaking coil you should obtain an exact duplicate replacement if possible. If you cannot, you should get all the information available on the characteristics of the original coil, and obtain a replacement as close as possible to the original characteristics.

Many peaking coils are wound on resistors. If the value of the resistor used in the original coil varies a small amount from the original resistor value this shouldn't affect the performance of the circuit too much. However, if the inductance of the replacement varies, the high-frequency response of the video amplifier will fall off and result in a loss of detail.

Other special coils encountered in a TV receiver such as pulse shaping coils, etc., should be replaced by exact duplicates wherever possible.

However, sometimes when these coils are not available, a number of similar coils may be tried until a satisfactory substitute is found.

If one of the coils used in the tuner of a TV receiver is damaged, it is usually impossible to obtain a replacement. Even if the replacement is available in most cases there is not much you can do with it, because the average serviceman does not have the equipment available to realign the tuner. Many distributors will exchange a defective tuner for one in good operating condition.

The cost of the exchange is far less than the cost of a new tuner, and, in most cases, the exchange tuner will work satisfactorily. If you run into tuner trouble, be sure to contact the distributor to see if he has this exchange service before deciding to buy a new unit.

Some TV receivers use what is known as a turret tuner and the replacement of coils is a comparatively simple task. The coils are arranged in strips that are held in position by a spring. The spring is simply moved back and the entire strip is removed. Replacement strips are available from the receiver distributor. If a replacement is not available, either of the adjacent channel strips may be used in many cases with slight realignment.

Transformers

There are several different types of transformers found in radios and TV receivers. In addition to power transformers, there are audio transformers and i.f. transformers. You may also call the antenna coil and the r.f. coil a transformer if you wish, but since we have discussed them previously we are not concerned with them now.

In replacing a power transformer in a receiver, it is seldom necessary to obtain an exact duplicate. As a matter of fact, in most cases you will find that the distributor does not have an exact duplicate replacement, and it will be necessary to use some substitute.

To obtain a replacement power transformer for a receiver, simply give your local wholesaler the manufacturer's name, model number of the receiver and the number and type of tubes used in it. He has catalogs that list the replacements that can be used in most receivers from which you will be able to select a suitable replacement.

In some cases you may find a replacement transformer is not listed. To select a suitable replacement, first examine the filament windings needed.

Usually you will need a winding for the rectifier tube. In most cases this will be a five-volt winding capable of supplying either two or three amps.

If your set uses a rectifier tube that has a current requirement of 2 amps, the replacement transformer could have a rectifier filament winding rated at either 2 or 3 amps. On the other hand, if your rectifier tube requires 3 amps, then the rectifier filament winding must be rated at 3 amps.

To determine the current required by the heaters of the remainder of the tubes in the set, consult a tube manual for the heater current required for each of the tubes. The sum total of the requirements of each of the tubes is the heater current required. Also allow for the pilot light, and this will give you the minimum current requirement of the second filament winding. If you find that you need a total current of 2 amperes you can use a transformer with the filament winding rated at 2 amperes or higher.

Now determine the B supply voltage and current. This is not as simple as it might seem. If you total the current requirements of the tubes from a tube chart, the value obtained will be somewhat higher than the current actually required in most cases. Count the number of tubes. From this information, and an approximate idea of the voltage and current requirements of the B supply, you can usually select a suitable replacement transformer.

You will find that replacement power transformers are listed in the catalog for receivers having so many tubes. Also, the current of the various windings is listed, and frequently the B voltage and current are given. By determining approximately how much current you will need, the approximate B supply voltage required, the number of tubes used in the set, and the filament current requirements, you should be able to select a suitable replacement transformer.

Older receivers use audio transformers between the detector and the first audio stage, and also between the various audio stages. In most modern superheterodyne receivers, the only audio transformer you will encounter is the output transformer. Usually a replacement output transformer is easy to select. The practice now is to use a "universal" replacement. When ordering a universal replacement give the type of output tube or tubes used. Hook up the transformer according to the manufacturer's instructions which are packed with the transformer.

For example, suppose the receiver uses a tube that is capable of supplying about nine watts of audio power. Obviously you could not use a three-watt transformer. You would have to use one that can handle at least nine watts. A 10-watt or 12-watt transformer could be used just as well.

If you know the voice-coil impedance of the speaker (this information is frequently given on the diagram or in a parts list) you can look in your tube manual to see what the normal load in the plate circuit of the output tube should be.

From the manufacturer's specification sheet supplied with the output transformer, you can de-

termine the connections that should be used to match the voice-coil impedance that you have to the desired load.

Most universal output transformers will have three primary connections. One connection is a center tap when push-pull amplifiers are used. In a single-ended output stage, the center tap is taped up—it is not used.

If you know the impedance of the voice coil, go right ahead and connect the speaker voice coil to the correct terminals of the output transformer. But if you do not know the voice-coil impedance, experiment with various secondary combinations until you find a combination that will give satisfactory quality. If you wish, you can measure the voice-coil resistance with an ohmmeter. The impedance is roughly 1.5 times the resistance of the voice coil.

To replace audio transformers in older receivers you must first find out whether the transformer is a step-up or a step-down transformer. To couple together two class A amplifiers, a step-up transformer is normally used. A transformer having a turns ratio of 1:2 or 1:3 will usually be satisfactory.

In some sets you will find that the output stage in the receiver is a class B amplifier. Whenever you run into this situation there will be two output tubes. In other words, a single-ended output stage is always a class A stage, and the transformer used between it and the previous stage can always be a step-up transformer. If a push-pull output stage is used, you must first find out whether it is a class A stage or a class B stage.

If it is a class B amplifier, then you need a step-down transformer. In addition to this information, when ordering a replacement transformer, you should specify the tubes. In other words, if the output tubes were type 45's, and the preceding tube were a single type 45, you would specify that you want a push-pull input transformer to match the grids of the push-pull 45 tubes to the plate of a single 45 tube. With this information, your wholesaler should be able to supply you with a suitable replacement.

There is usually no great problem in selecting a replacement i.f. transformer. You simply specify the i.f. frequency, and make sure that the replacement transformer is approximately the same physical size. Actually, the change in physical size is not too important, but sometimes you run into mechanical difficulties when mounting the replacement, particularly if it is larger than the original. The trend in modern receivers is to use the miniature type i.f. transformers, but the larger i.f. transformers are still available. The i.f. transformer used originally in the set may be permeability-tuned. In other words, the transformer is peaked by varying the inductances. You can use a standard replacement transformer in which the capacity rather than the inductance is varied.

Be sure to specify whether it is to be used as an input or an output i.f. transformer when ordering a replacement. Most manufacturers make separate types. Also you should specify the number of i.f. stages used in the receiver. For example, the input i.f. transformer used in a set having a single i.f. stage is frequently different from the input i.f. transformer used in the set having two i.f. stages.

In recent years some manufacturers have come out with a universal replacement i.f. transformer that can be used as an input or an output i.f. transformer, or it can be used in a single i.f. stage, or in a set having two i.f. stages. If you obtain this type of transformer you need not specify exactly where it is to be used in the circuit. Otherwise you should give this information to be sure that the replacement transformer will give the best possible results.

You will find i.f. transformers used in FM receivers. The standard i.f. frequency is 10.7 megacycles, and these transformers are readily available at most wholesalers. Some manufacturers use a slightly different i.f. in FM receivers, and if possible, a transformer designed for this frequency should be used. But in most cases a 10.7-megacycle i.f. transformer can be installed and adjusted to the new frequency without any trouble.

There are two types of i.f. transformers in television receivers. One type is a transformer in the true sense of the word having two or more windings. When it is necessary to replace this type, you must obtain an exact duplicate replacement.

The coupling between the two windings is usually quite critical, and unless you obtain an exact replacement, the i.f. band width of the receiver may be changed.

Most TV receivers use stagger-tuned i.f. amplifiers. In these sets you will frequently find a single coil with an iron core used in either the plate circuit or in the grid circuit of the i.f. stage. A circuit such as shown in Fig. 3 is common.

In this type of circuit using a single coil, the value of the transformer is not so critical. Considerable variation can be taken care of by adjusting the transformer core. In aligning the sets the transformers are usually peaked at various frequencies, and any discrepancies between the value of the original and the value of the replacement will be taken care of in the alignment.

With the exception of over-coupled i.f. transformers, such as found in some TV receivers, you

should not have very much trouble obtaining a suitable replacement transformer.

Speakers

Most modern receivers use permanent magnet dynamic speakers which are easy to replace. You can usually obtain the speaker diameter and voice coil impedance from the manufacturer's service data on the set. If the manufacturer fails to list the speaker size you can measure it with a ruler.

Many of the older receivers used electrodynamic speakers. In some cases the field is connected across the B supply and serves only as a field. An example is shown in Fig. 4. When replacing one of these electrodynamic speakers used in a circuit of this type there is no need to be concerned about the speaker field; you can use a permanent magnet dynamic speaker, and simply ignore the field connections. If this is done, you may connect the two cathodes of the rectifier together. Of course, if you wish, you can use a similar electrodynamic speaker.

In many receivers using an electrodynamic speaker, the speaker field is used as a filter choke. If a permanent magnet dynamic speaker is used to replace the original electrodynamic speaker, you must do something about the speaker field being removed from the circuit. In some console receivers, you can simply mount the old speaker on the bottom of the cabinet and leave the speaker field in the circuit. However, frequently there isn't room to do this, or the speaker field may be burned out.

In this case you can use an iron core filter choke instead of the speaker field. If the resistance of the choke is somewhat less than the resistance of the speaker field, it probably will not result in any trouble. It will simply mean that the operating voltages in the receiver will be slightly higher. However, if this increase in operating voltages results in oscillation, you can always bring the operating voltages down to their original value by putting a resistor in the circuit whose resistance, plus the choke resistance, will be equal to the resistance of the original speaker field.

Sometimes it is possible simply to insert a resistor in the circuit in place of the speaker field. The value of the resistor usually is not very critical.

In AC-DC receivers a 1000-ohm resistor is normally used. The speaker field resistance usually is about 300 ohms, but a 300 ohm resistor is not large enough to give effective filtering. To counteract the increase in resistance in the filter network, the plate lead from the output tube must be moved from the output of the power supply over to the cathode of the rectifier as shown in Fig. 5. The dotted lines show the original plate lead connection and the solid line the change.

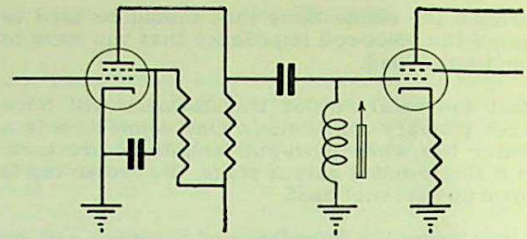


Fig. 3

This change reduces the current through R and the voltage drop across it. It is possible to do this because the plate current of an output tube will not change appreciably with small changes in supply voltage present at the rectifier cathode.

The other electrodes however require a well filtered suply. In AC-operated sets where the resistance of the original field may have been as high as 2000 ohms, you could install a resistor of this value in the circuit and try it. You may have excessive hum, and it may be necessary for you to either install a choke or increase the size of the filter condensers to get rid of this hum. It is worth trying a resistor though because it is usually less expensive than a filter choke.

To select the resistor you must also consider the wattage ratings; usually a 5-watt resistor will be large enough in an AC-DC receiver, but in an AC-operated set it might be necessary to use a resistor having a wattage rating of 10 watts to allow a reasonable safety factor.

When ordering a replacement speaker you should try to obtain one with the same voice-coil impedance. However, if the manufacturer does not give the voice-coil impedance of the original speaker there is no convenient way to determine it. If the set is a new receiver, the chances are it uses a speaker whose voice coil impedance is approximately 3 ohms. Most new sets have a speaker voice-coil impedance of 3.2 ohms. It probably would be a good guess to try a speaker having this voice-coil impedance as a replacement. (In older sets a somewhat higher voice-coil impedance is found. A 6-ohm or a 8-ohm voice-coil impedance is common.)

One way to get around this problem is to buy the speaker complete with an output transformer designed to match the output tube or tubes used in the receiver. In this way you need not be concerned about the voice-coil impedance, because the new output transformer will take care of that. However, if you want to use the old output transformer, you should try to obtain a replacement whose voice-coil impedance is as close as possible to the voice-coil impedance of the original unit. Some variation will not be noticeable,

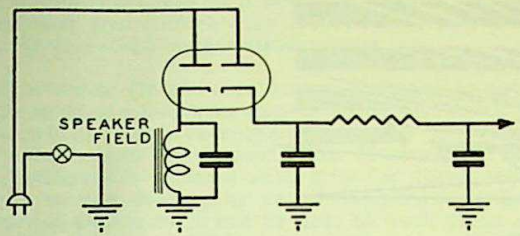


Fig. 4

but too much will result in a noticeable change in tone.

Tubes

The problem of tube substitutions is far too complicated to be treated in this article. However, there are a few general suggestions that should be helpful to you.

The first thing you should do when it is necessary to replace a tube is, of course, to try to obtain the correct replacement. If you can't do this, consult the tube manual and the schematic diagram to determine the type of the tube. For example, you can find out whether the tube is a diode, high mu triode, low mu triode, etc. Also, find out the heater voltage and the heater current. This information will be enough to start with.

Next, examine the receiver diagram to find out the purpose of the tube in the set, and determine whether the heaters in the receiver are connected in series or in parallel. In an AC-DC receiver, the heaters of the various tubes will be in series, and in an AC-operated set using a power transformer they will usually be in parallel.

If the heaters of the tubes in the set are connected in series, a replacement tube must necessarily have the same heater current rating as the original. If the heaters of the tubes are connected in parallel, then the replacement must have the same voltage rating as the original.

Once you have determined whether the heater voltage or the heater current must be the same as the original, you can consult your tube manual for similar tube types. Many tube manuals have one section where the tubes are grouped by types; this arrangement is helpful in quickly selecting possible replacements.

After you have selected possible replacements for the original tubes, check on other details such as the amplification factor, trans-conductance, or normal operating voltages. If the tube should be a rectifier, check on the peak inverse voltage and the maximum current that can be handled by the tube.

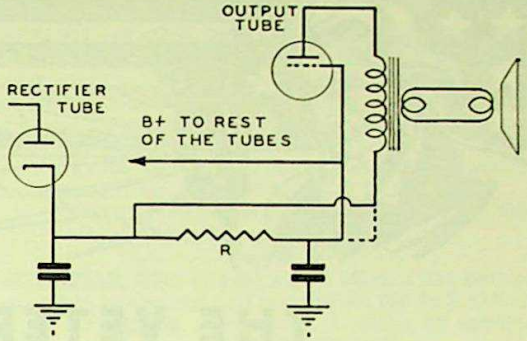


Fig. 5

If you can find a tube that resembles the original one electrically, except, for a few possible minor variations, it might be possible to use this tube as the substitute. Certainly it would be well worth trying if you cannot get the original tube.

In many cases you will find, after studying the substitutes, that there are several tubes that could be used. Once you have narrowed the field down to a few tubes, find out first if these tubes can be obtained. If they are all available, then select the tube that can be installed in the set with the least amount of work.

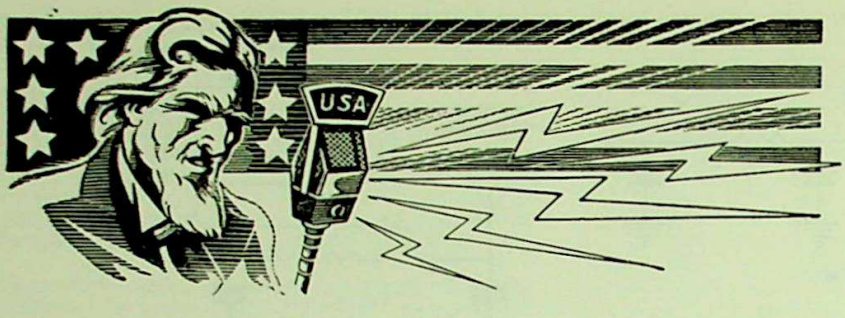
For example, suppose the 50L6 tube in the receiver has burned out and you found it impossible to obtain a replacement. When you check the tube manual for a possible substitution you will find that either the 50A5, 50B5, and 50C5 could be used. You would also find that the 35L6 could be used if the heater voltage could somehow be changed to 50 volts. In this particular case you could change the heater voltage quite easily simply by inserting a resistor in the series circuit to take care of the extra 15 volts.

However, let us assume that the 35L6 tube is not available and you must use one of the other tubes. In this case the 50A5 would probably be the best replacement, because it would be easier to remove the octal socket and install a loctal socket in its place than it would be to remove the octal socket and install a miniature socket required by the other tubes.

Sometimes minor changes in the circuit can be made that will permit a tube substitution. For example, in Fig. 6, a typical video i.f. amplifier using a 6AU6 tube is shown. If you were looking for a substitute for this tube, you would find that a 6AG5 could be used. However, the base connections on a 6AG5 are somewhat different.

Therefore, by removing the ground connection

(*Page 26, please*)



THE VETERAN'S PAGE

Devoted to news items and information of special interest to veterans taking NRI courses under the GI Bill of Rights.

In Case You Missed Previous Announcements

Several issues of the *News* have carried explanations of the date—July 25, 1951. This summary of previous articles is included for the benefit of those who enrolled recently or who overlooked or forgot previous warnings.

As of the date we went to press, VA regulations will not permit starting new courses under the GI Bill after July 25, this year. Generally speaking a veteran who is in training *on* July 25 may continue after that date, but a veteran who is NOT in training *on* July 25 can as a rule neither start a new course nor resume one he previously interrupted.

There are important exceptions to the prohibition against resuming courses after July 25. The most important one is that veterans who interrupted because of military service will be permitted to resume even after July 25, under certain conditions.

We can give limited information to veterans discharged after July 25, 1947 and to men in service who interrupted courses and cannot resume work before July 25; but the proper place to get information is your VA regional office. If your case is one of these, get the VA statement in writing.

Verbal explanations are often made without reference to your record and may overlook important facts.

Students now taking their first course at NRI and who are fairly well along in their training will want to finish just as soon as possible in order to:

1. Qualify for better jobs more quickly.
2. Take the other NRI course, if they're interested.
3. Take other training elsewhere if it is more to their advantage.

These are compelling reasons for every student to set up a schedule for himself to complete his present course by late May or early June, if it is at all possible for him to do so.

Whether the reader is a graduate or a student, he should do some planning. He should look ahead far enough to decide what additional training he may need in the next several years. If he is going to need greater skill or special schooling in 1952, the course must be started well in advance.

It is unimportant whether you propose to take a second course under the GI Bill at NRI or elsewhere. The important part is that you plan to enroll for the additional course *well in advance of July* 25, 1951.

If you are now studying under the GI Bill and plan on another course also under the GI Bill, set up and follow a schedule of study that will assure your *finishing* your present course by the end of May, 1951. Allow *plenty* of time for obtaining VA certification for the new course. Quite

possibly there will be a last-minute rush for certificates just before July 25. Planning now will help to avoid disappointment then.

Graduates: Obtain certificates of eligibility *now*, no matter when you expect to enroll. When a certificate has been received from the VA, it can be held until enrollment time. If *obtaining* the Certificate is delayed until time for enrollment, the issuing delay may cause complications. Regional Offices may not be able to issue them as promptly as heretofore.

Students: You cannot obtain another certificate for other training until you graduate (or interrupt) your present course; the application form for the new certificate must show the date of completion of present course.

Active students will fall into one of three groups:

1. Those who desire no further training.
2. Those who would like to take other training under the GI Bill but whose time for study will not permit them to graduate from the present course and enroll for another before July 25.
3. Those who want other training and who CAN graduate in time to supply us with a certificate for a second course before July 25.

Whether or not students in Group 3 actually get enrolled for another course is up to them. They determine whether or not the work is completed. They govern the date of graduation.

A Bill has been introduced in Congress to extend the cut-off date for starting courses. You should NOT count on its passage. If it passes you will have an added opportunity to train. If it *doesn't* pass, you have lost nothing by aiming at July 25, 1951.

Men In Service

So far as the Institute is concerned, you may continue GI courses while you're on active duty.

We are required to interrupt GI courses where no work arrives for grading in over four months. If you are in Service and must interrupt, and if Service prevents you from resuming training by July 25, present regulations will permit you to resume the course after discharge (up to a reasonable time). Being able to resume interrupted courses after July 25 *generally* does *not* apply to other veteran students.

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We repeat these notices so that every GI student may be warned ahead of time that GI courses generally cannot be started after July 25, 1951, *the way the law stands* as of press time.

Employment Opportunities

SPERRY GYROSCOPE COMPANY (Great Neck, Long Island, N. Y.), recently notified us of approximately 100 positions open in their Test Department. Openings are for Technicians and Testers in Electronic, Microwave, and Electro-mechanical fields. Qualified men should find these positions worth consideration. Letters of applications should be sent DIRECTLY TO:

SPERRY GYROSCOPE COMPANY, Personnel Div.
Great Neck, Long Island, N. Y.

———*n r i*———

SUPREME, INC. (Greenwood, Miss.), has several openings in testing and inspection for technicians with training in electronics. Letters of application should be sent DIRECTLY TO:

SUPREME, INCORPORATED, Personnel Div.
Greenwood, Miss.

Letters should include height, weight, marital status, education and experience, and three personal references.

———*n r i*———

BRANIFF INTERNATIONAL AIRWAYS (Love Field, Dallas, Texas), has several openings for both radio operators and radio mechanics in Dallas, Texas. They are considering men who hold FCC 2nd Class Radiotelephone licenses, and who have had training and/or experience in aircraft radio. Letters requesting more information should be sent DIRECTLY TO above address.

———*n r i*———

The following **SIGNAL REPAIR SHOPS** have been recently activated and may require personnel experienced in repair of Radio, Radar, Telephone, Telegraph, and Teletype Equipment, etc.:

Camp Campbell, Ky. . (Commanding General)
Fort Eustis, Va. ..... (Hdqrs. Second Army)
Camp Pickett, Va. .... (Attn. Signal Officer)
Camp Stewart, Ga. .. (Commanding General)
Camp Rucker, Ala. ... (Attn. Signal Officer)
Camp Polk, La. ..... (Commanding General)
Camp Chaffee, Ark. .. (Attn. Signal Officer)
Camp Atterbury, Ind. . (Commanding General)
Camp Carson, Colo. .. (Hdqrs. Fifth Army)
Fort Custer, Mich. ... (Address Chicago, Ill.)
Camp McCoy, Wisc. .. (Attn. Signal Officer)
Fort Riley, Kans. .... (Commanding General)
Camp Cooke, Calif. .. (Commanding General)
Camp Roberts, Calif. . (Hdqrs. Sixth Army)

Letters of inquiry from interested students and graduates should be sent DIRECTLY to the above addresses, not to NRI.

———*n r i*———

U. S. NAVAL PROVING GROUND (Dahlgren, Va.), openings for operators and maintenance men in connection with electronic calculating machines.

———*n r i*———

Applications from men with first-class radiotelephone licenses have been requested by:

Station KRRV, Sherman, Texas.
Station KFTV, Paris, Texas.
Station WLCX, La Crosse, Wisc.
Station WKVA, Lewistown, Penna.

(*Continued from page* 23)

on the No. 2 pin you could install the 6AG5 in the circuit in place of the 6AU6. If the ground connection were not removed, the cathode resistor would be shorted out of the circuit, and this might result in oscillation.

Suppose the situation were reversed, and the 6AG5 were in the amplifier and you wanted to replace it with the 6AU6. You can do this simply by connecting together the No. 2 pin and the No. 7 pin on the tube socket. This connection is necessary, because the cathode and the suppressor grid are not tied together inside the 6AU6 tube, where as they are tied together inside the 6AG5 tube.

Suitable selection of replacement tubes involves considerable work, and there is always the possibility of making a mistake. The easiest way out is to obtain a tube substitution book which lists the substitutions for most tube types. You can obtain one of these books from almost any wholesaler. Sylvania puts out a tube substitution book which is available, at no charge, from any distributor, who handles Sylvania tubes. Several publishers have released tube substitution books that can be purchased for a reasonable price.

It definitely would be worth while to obtain a tube substitution book, since tubes are becoming increasingly difficult to obtain, and there will be occasions when you must make substitutions in order to get the equipment operating. When a certain tube is listed and no substitute is given, you can assume that there is no tube that can be readily substituted for it. However, if the tube is not listed, it may be a new type. In this case you might be able to find a substitute for it if you can obtain the tube characteristics. Once you have the tube characteristics you can consult your tube manual using the method suggested previously to find similar types. Then check the electrical characteristics to see if they resemble the characteristics of the required tube closely enough to permit substitution.

In many cases you will find that tubes are directly interchangeable. When a certain tube type that you plan to stock is not available, be sure to check for tubes that are directly interchangeable.

With parts and tubes becoming increasingly difficult to obtain, and with many old receivers still in use, servicemen must be prepared to make substitutes. As pointed out in this article, it is permissible, and it is usually possible to obtain some substitute part that will give satisfactory service.

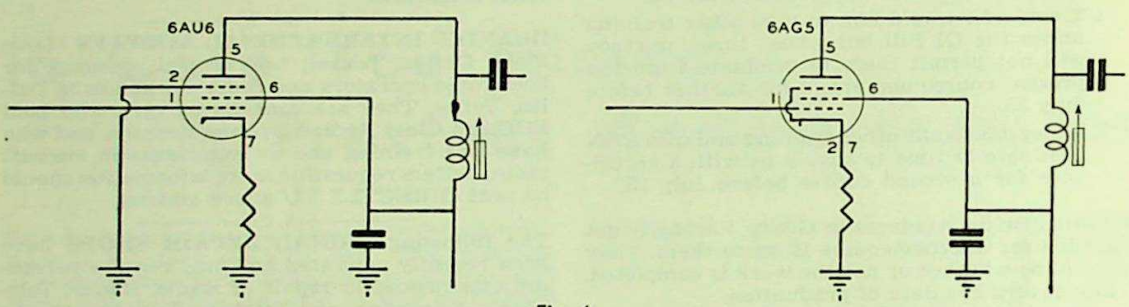


Fig. 6

Electrostatically-Focused TV Picture Tubes

National Union Radio Corp., of Orange, N. J., has just announced the development of TV picture tubes which will save over two pounds of copper in each TV set by utilizing electrostatic focusing in place of electromagnetic focus. These tubes are now available in 14, 17, and 20-inch rectangular designs, and can be used in place of the same sizes employing electromagnetic focusing.

Electrostatic focusing is achieved through the use of a new electron gun having a focusing electrode. This electrode, operating at approximately 20% of the anode potential, is designed to operate with essentially zero current. The focusing potential is easily obtained from a conventional flyback type power supply employing a low cost rectifier operated from the primary of the horizontal-deflection amplifier transformer. Variations in centering due to external conditions are readily compensated by the use of electrical centering in the deflection yokes.

Mechanically, the new N.U. tubes will be interchangeable in set designs using either the so-called short or long neck-length tubes. Electrically, the ratings for these electrostatically focused tubes are the same as for electromagnetically focused tubes.

RADIO STATIONS KFH & KFH-FM

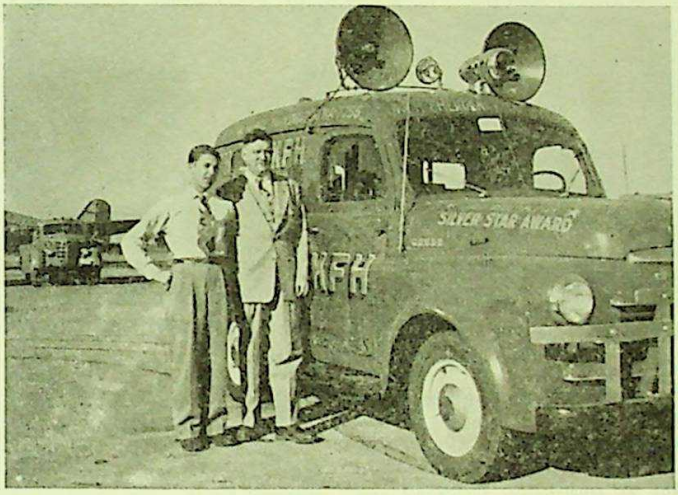
WICHITA
7TH FLOOR KFH BUILDING

KFH
CBS

KANSAS
TELEPHONE 24491

ESTABLISHED 1922 - THE OLDEST STATION IN KANSAS
The Voice of The Wichita Eagle

Remote and Mobile Units Constructed Under Direction of NRI Graduate



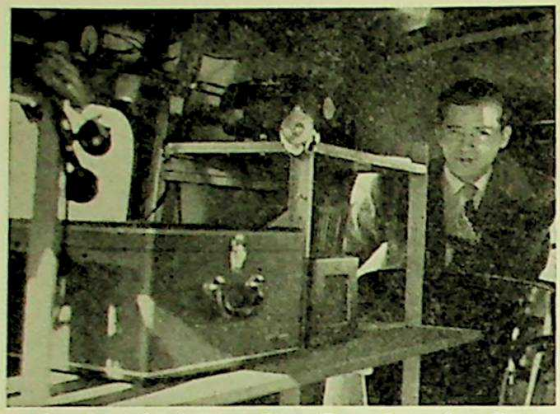
Mobile Unit KA-7765, 26.21 mcs., 26.31 mcs., and 26.41 mcs., F.M. Antenna for transmitter shown in folded position. NRI Grad T. L. Kidd, (right) chief engineer of KFH & KFH-FM, and Don Munson (left) are shown in the photograph.

IN a modern broadcast station there is a very definite need for a mobile unit, capable of being used instantly, day or night, for the coverage of news on the spot, while it is happening, as well as many other events, such as sports events, interviews at various points, and special events.

The General Manager of Radio Station KFH (5KW) and KFH-FM (10KW), Mr. Frank V. Webb, ordered the Engineering Department of KFH to undertake the construction of such a unit. The design of the unit was under the direction of NRI Graduate T. L. Kidd, Chief Engineer of KFH and KFH-FM. Actual construction was done by the entire staff of engineers.

A Dodge Panel Truck was purchased as the foundation unit for the mobile equipment. Special shelves and tables were designed to accommodate the proposed installation. These shelves were constructed of welded channel iron with plywood filler. Large glass windows were installed in the center section of the panels on both sides of the truck, so that the engineer inside the truck can have a clear view of any event happening outside the truck.

On the right-hand side of the truck is installed a Type BC-603 receiver, modified for 6 volt operation. A separate power supply was constructed and mounted on the left side of the receiver. In

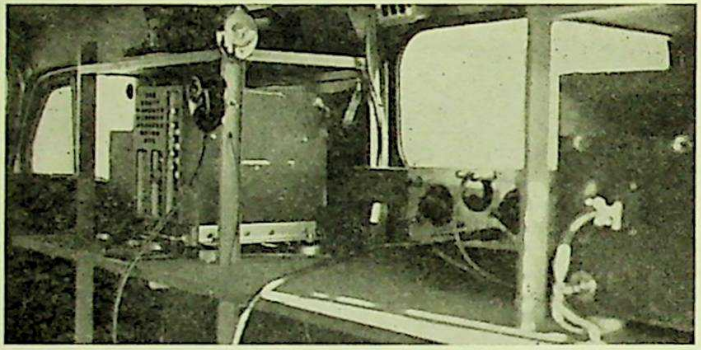


Inside of truck, showing Eicor Tape Recorder, Carter Dynamotor, and Don Munson.

with the transmitter, which is wired with No. 000 wire. Total current drain of all equipment is well in excess of 100 amperes.

The roof of the truck supports a large siren with rotating red light, spot light, two University 25 watt speakers, and a vertical antenna (which may be tied down for low clearance). A separate antenna is used for the transmitter, 26 MC. receiver, and the broadcast receiver, making a total of three antennas on the truck. Three frequencies are used, 26.21 MC, 26.31 MC and 26.41 MC.

A BC-603 receiver and BC-604 transmitter are also mounted on top of the studio building, 178 ft. above street level. This unit is operated entirely by remote control from the Master Control Room. A vertical dipole is used, with switching relay. Excellent results have been obtained with both units up to 25 miles.



Inside of truck. BC-603 Receiver (left); Control Panel (center); BC-604 X-Mitter (right).

the center section is mounted the control panel which gives the operator two microphone inputs, as well as a volume indicator meter, dynamotor switches, indicator lights, etc. In the last section a BC-604 transmitter is mounted. Feed to the vertical antenna is through a 9 ft. section of RG8U Co-axal cable. All equipment is mounted on rubber aircraft type shock mounts.

On the left side of the truck is mounted an Eicor Tape Recorder, and a 25 watt Masco Public Address System, complete with turntable, etc. There is also a 60 watt Carter 6 V. D.C. to 115 V. A.C. converter mounted on the top shelf to supply AC to the tape recorder.

An interesting feature of the installation is a separate battery system installed to operate the radio transmitter and other special equipment. This battery installation consists of a 200 ampere-hour battery, a 75 ampere generator, voltage regulator, ammeter, etc.

All wiring to the equipment is with No. 2 wire, except from the PE-103 Motor Generator used

Remote Station KAB-773-F.M. Virgil Hinshaw (left) and T. L. Kidd (right).

N.R.I. ALUMNI NEWS

Words Alive in Meaning

Daniel Webster, were he alive today, would probably be called a conservative, a stand-patter, a die-hard. He spoke in Boston, at the dedication of the monument to commemorate Bunker Hill. The words he spoke are still so alive in meaning and application that it's absolutely uncanny. If we actually heard them today, who would guess that they originated over a hundred and twenty-five years ago . . . in 1825 . . .

"If the true spark of religious and civil liberty be kindled, it will burn. Human agency cannot extinguish it. Like the earth's central fire, it may be smothered for a time; the ocean may overwhelm it, the mountains may press it down; but its inherent and unconquerable force will heave both the ocean and the land, and at some time or other, in some place or other, the volanco will break out and flame up to heaven . . . God grants liberty only to those who love it and are always ready to guard and defend it . . . America has furnished to Europe proof of the fact that popular institutions, founded on equality and the principle of representation, are capable of maintaining governments, able to secure the rights of person, property and reputation.

"America has proved that it is practicable to elevate the mass of mankind . . . to raise them to self-respect, to make them competent to act a part in the great right and great duty of self-government; and she has proved that this may be done by education and the diffusion of knowledge."

Chapter Chatter

Philadelphia-Camden Chapter reported their new Officers too late to catch the previous issue of the *News*. Here they are: Chairman, Norman Kraft, 6 South 8th St., Perkasie, Penna. Vice Chairman, Harvey Morris, 6216 Charles Street, Philadelphia. Recording Secretary, Julius Cohen, 2527 No. Marston St., Philadelphia. Financial Secretary, Laverne Kulp, 701 York Ave., Lansdale 4, Penna. Treasurer, Charles J. Fehn, 3411 Helen St., Philadelphia. Librarian, Raymond Weidner, 5341 Darrah St., Philadelphia. Sgt.-at-Arms, Raymond E. Stout, 304 Elm St., Westville, N. J.

We are having some excellent meetings with Harvey Morris, Charles Fehn, Cliff Hill, Bob Meli, Norman Kraft and others leading the discussion periods. . . . Mr. Bycer, Service Manager, Lehigh Radio and Television Co., gave a very interesting talk on Horizontal Output Transformers and Circuits. We expect Mr. Bycer back again soon for another excellent talk.

Secretary Jules Cohen doing a fine job . . . missed him for several meetings while he was out with the flu . . . our member Fred Seganti of Feasterville, Penna., reports his business has grown from a part-time Radio and Television into full-time. Nevertheless he attends meetings regularly and says he profits very much through his association with our members. . . . Harvey Morris, who is Service Manager for Whelan Radio Company, each meeting brings us the benefit of his interesting experiences. Harvey is a whiz on TV servicing.

We still meet on the second and fourth Monday of each month at the K of C Hall, Tulip and Tyson Streets in Philadelphia.

New York Chapter is all hopped up over the fact Lou Kunert has been elected a Vice President of the NRI Alumni Association . . . was sworn-in by past International President Frank Zimmer. James J. Newbeck is well along in his series of twenty-four lectures which he is giving, one each meeting, on Television, theory, practice and trouble-shooting. He plans to cover every phase of Television from A to Z. The talks are accompanied by practical illustrations and demonstrations whenever possible. . . . At the close of each lecture, opportunity is given to ask questions. We are proud of members such as Jimmy Newbeck . . . his lectures are making a tremendous hit. In recent talks he covered "Analyzing Front Ends," "Input Tuners" and "R.F. Alignment."

Chairman Bert Wappler, Alex Remer, Frank Zimmer, Tommy Hull and Lou Kunert meet at regular intervals to plan programs far in advance . . . these men comprise the Executive Committee.

Things have been going so well in New York Chapter that the members voted to re-elect the entire slate of Officers. A real compliment to Chairman Bert Wappler, Vice Chairman, Alex Remer, Secretary-Treasurer, Lou Kunert and Assistant-Treasurer, Frank Zimmer . . . meetings are held on the first and third Thursday of each month, at St. Mark's Community Center, 12 St. Mark's Place, between 2nd and 3rd Avenues, in New York City.

Chicago Chapter is coming along rapidly under the leadership of Chairman Mead . . . mighty interesting notices being mailed by the Chairman and Secretary, Mr. Raymond J. Brooks . . . a real business-like administration.

Executive Secretary, L. L. Menne, was a recent visitor. At that meeting Louis Brodhage, one of our very capable members, delivered an excellent talk which he termed "All About Bias." His talk was supplemented by a large schematic which must have taken hours to prepare. Fine spirit . . . fine talk and very much appreciated.

Refreshments are served at most of our meetings. If you live in the Chicago area and want to get up in the world come and see us . . . we meet in the Tower Space at 666 N. Lake Shore Drive. Enter building through the West door. Take elevator as high as you can go . . . and then walk a flight or two . . . bring a Radio receiver . . . we will be glad to help you with it.

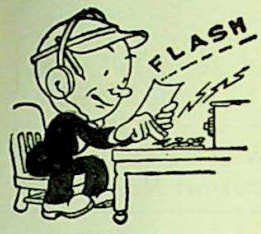
Detroit Chapter is going along serenely as usual. . . . Chairman Stephens is getting fine cooperation from all of the Officers and members. . . . Harold Heipel, a service Engineer for our former Chairman, Harold Chase, gave us a very good lecture on Television installation and adjusting. . . . Mr. Chase can be very proud of men such as Heipel.

At another meeting Earl Oliver conducted the usual service forum. Members bring in sets on which they are stumped . . . at another meeting Earl Oliver gave a talk on TV servicing . . . the Chapter has purchased a full line of NRI test instruments and these will be put to work in connection with our RCA demonstration board. Charles Mills is scheduled for a talk on the TV kit the Chapter has been assembling during the past several months.

Detroit Chapter meets on the second and fourth Friday of each month at Electronics Institute, 21 Henry St., at Woodward.

Baltimore Chapter misses the usual prompt reports submitted by Secretary Thomas Kelly who has been pressed into night work temporarily. In the meantime, Arthur F. Lutz, is filling in as Secretary and doing a good job having had years of experience in this very office.

Chairman Elmer Shue is making good on his promise to make this a banner year for Baltimore Chapter. Meetings are held on each Tuesday evening of the month (except the first Tuesday) at Redmen's Hall, 745 W. Baltimore Street.



Here And There Among Alumni Members

H. J. Price, owner of Price's Radio Service, Spartanburg, S. C., writes that, thanks to NRI training, he has increased his income greatly. Price has his own shop, truck, and equipment. Has four men working with him in Radio and TV.

———n r i———

Alumnus Jack Helsdon, of Tilsonburg, Ont., Canada, sends a splendid report. Helsdon is now Chief Technician and Supervisor over Radio and Television Service with a very large store in his city. He says that Television is becoming "quite a business."

———n r i———

Walter Burdine, Waynesville, Ohio, reports new amateur station call letters W8ZCV. He mentions that he is on all bands as high as 420 megacycles.

———n r i———

A letter from NRI Graduate Corporal Donald S. Lambert, written from Miryang, Korea, explains that he will have to postpone his plans for additional training with NRI because "present conditions make such study impossible." (Ed.—we hope "present conditions" will soon improve.)

———n r i———

The honeymoon trip of NRI Graduate and Mrs. Chet Lane, of McKeesport, Pennsylvania, included a visit to NRI and a chat with Chief Instructor Dowie. The Lanes are proud owners of a Radio-Television Installation and Service business in McKeesport.

———n r i———

Graduate A. Di Cristina, of Newark, New Jersey, reports passing the FCC examination for a second-class Radiotelephone license. Congratulations.

———n r i———

Corporal James E. Norma writes from Kelly Field, Texas, telling us that NRI training has brought him a good job with promotions in the Armed Forces.

———n r i———

Graduate George W. Wiggle says "the NRI training I received is now reaping great rewards." He is handling all of the Radio and TV Installation Service for "PEARL'S" of Phoebus, Virginia.

———n r i———

Benoit Parent, St. Isidore Dorchester, Quebec, Canada, has his own spare-time business. For the past 12 months his profits were between $400 and $500 in a town of 2,000.

———n r i———

Graduate Edward C. Gasper, Murrysville, Penna., writes "Have been servicing Television since October. Am sure glad I took your course."

———n r i———

Alumnus Donald H. Peters, Findlay, Ohio, recently passed the FCC second-class Radiotelephone examination. Twelve days after obtaining his license, he began as a Radio operator at Station KQB-356, with the Ohio State Patrol. Says NRI background enabled him to get the type of work which he really enjoys.

———n r i———

Pfc. Bernard E. Barnett, now age 20, and an NRI graduate, amazed officers at Scott Air Force Base by taking in one day and passing, with ease, all examinations for ten weeks of his Radio course. He completed the first twenty-five weeks of the Radio Mechanics course in fifty-six hours of work. Remarkable!

———n r i———

R. L. Burlingame, of Berrien Springs, Michigan, stopped for a visit at NRI while on his way to a Marine Corps base to report for active duty. We enjoyed his visit.

———n r i———

Graduate William J. Houston, Scranton, Penna., has been called into the Navy from the active Naval Reserve, for duty as an Electronics Technician, first-class.

———n r i———

Leslie A. Proctor, of Scottsbluff, Nebr., recently returned to his old job as Chief Engineer of KNEB. (He put KNEB "on the air" in 1948). At present they are installing directional equipment. However, Proctor is being called back to the service soon.

———n r i———

Alumnus Oscar T. Pugh was mighty proud to visit NRI recently and to tell us about his growing Radio and Television Service business, "Pugh's Radio Service," which he opened in Roanoke, Virginia in December, 1947. George T. Crowe, and Robert F. Conlon, both NRI men, are also now employed by Pugh's Radio Service.

———n r i———

A nice letter from Kenneth Robieson of Minneapolis, Minnesota, tells us that he has been employed with the CAA as Aircraft Communicator for the past twelve years. Robieson graduated from NRI in 1938.

———n r i———

W4SGT are the new call letters for the amateur station belonging to Doctor C. R. Smith, of St. Petersburg, Florida. Amateur Radio is Doctor Smith's hobby.

———n r i———

NRI Graduate M. Madison Clews has started his own Television Service business in Rio de Janeiro. He reports only one station is on the air, and this from one until six p.m., which limits working hours. Although T.V. is going over well, he says that it is still at the point where a considerable profit can be made by an individual assembling and selling a set. Commercially manufactured TV sets are bringing prices twice those in the U.S.A.

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L. L. MENNE, EDITOR
H. L. EMERSON, ASSOCIATE EDITOR
J. B. STRAUGHN, TECHNICAL EDITOR

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